SACRED PHILOSOPHY

OF THE

SEASONS;

ILLUSTRATING

THE PERFECTIONS OF GOD

IN THE

PHENOMENA OF THE YEAR.

BY THE

REV. HENRY DUNCAN, D.D.,

RUTHWELL.

SPRING.

Lo! The winter is past; the rain is over and gone; the flowers appear on the earth: the time of the singing of birds is come, and the voice of the turtle is heard in our land.'—Song of Solomon.

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'I come! I come! Ye have called me long,
I come o'er the mountains with light and song!
Ye may trace my step o'er the wakening earth,
By the winds which tell of the violet's birth,
By the primrose stars in the shadowy grass,
By the green leaves opening as I pass.'—

MRS. HEMANS

STEREOTYPED BY T. B. SMITH,
216 WILLIAM-STREET, NEW YORK.

ADVERTISEMENT.

The present Volume is one of a series, the object of which is to demonstrate the existence and the attributes of God, in the various phenomena of the revolving year. Each volume contains an argument complete in itself, and peculiar to the season of which it treats. The present exibits proofs of the Divine agency in the reproductive powers and processes of creative things, with reference to the qualities of the atmosphere, the diffusion of light and heat, the deposition and distribution of moisture, the properties of the soil, the nature of the living principle, the development of seeds and plants, the animal structure and instincts, &c., &c. A similar arrangement is adopted in this Volume as in that on 'Winter,' the argument commencing with the consideration of the arrangements and adaptations of inorganic matter, and thence proceeding from the lowest to the highest orders of organized existences, through the various genera of plants and animals.

The latter part of the Volume is devoted to an exemplification of those adaptations and properties in the soil,

and in vegetable substances, which give rise to, and reward the labours of the agriculturist, and which thus lay the foundation of civilized society, and afford a stimulus to progressive improvement in the arts and sciences.

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SPRING.

FIRST WEEK—MONDAY.

GENERAL CHARACTER OF SPRING IN TEMPERATE CLIMATES.

SPRING has been celebrated in glowing terms by the poets of all ages; but in the climate of Britain, if we count the season by the calendar, the weather is by no means so mild and delightful, especially in the early part of this quarter of the year, as it has been painted. In Greece and Rome, indeed, which were the birth-places and nurseries of European poetry, the temperature of the air, the pure blue of the sky, the soft green of the opening leaves, the thousand delicate tints of the flowers scattered so profusely over hill and valley, with the perfume which they exhale, and the music poured from every grove—all unite to fill every sense with enjoyment. *There*, the descriptions of the enraptured muse are true to nature, and the inhabitants of such latitudes feel that the language of poetry is only a transcript of their own sensations. But it is not so in more northern climates, such as our own. Our bards, indeed, equally kindle and burn when SPRING is their theme; but they often glow with a borrowed warmth. Their taste and fancy, having been moulded by the Greek and Latin authors, almost unconsciously transport them to the classic ground from which their models drew their images, causing them to breathe, as it were, the same atmosphere, and to luxuriate in the same delicious climate.

It would be more gratifying to the acumen of the critic, than pleasing to the feelings of the man of taste, to examine how much of the language and imagery of our national poetry, relative to Spring, is drawn from classic ages and classic scenery, and then to estimate what remains of direct inspiration poured into the soul, in this changeable and backward climate, from our own earth, and sea, and sky. I have no relish for such an inquiry, though it seems to be almost forced on the mind, in comparing the 'ethereal mildness' and balmy sweets which breathe in Spring, as portrayed by the British Muse, with our actual experience of a British atmosphere, and of the vernal productions of a British soil. The real Spring of our climate can scarcely be said to be fairly set in, at least in the northern division of the island, till the commencement of summer.

In the month of February, winter not only lingers but rages. Our rivers, ponds, and lakes, are often still either rigidly bound in icy chains, or only partially disengaged from them; and, in some respects, the severity of the climate is frequently even more intense than during winter itself. Sometimes the tempest howls with redoubled fury, driving broad flakes of snow through the darkened air, and encumbering the wide earth with its drifted heaps; and, while the herds on the low grounds stand forlorn and destitute of food, the flocks on the hills are in danger of finding a sudden grave at the bottom of the precipice, whither they have fled for shelter. At other times, the cold and sleety rain falls in torrents, carrying along with it the snow which it has melted in the mountains, and spreading dismay and ruin over the inundated valleys; and, at other times again, the hoar-frost lies thick and chill, and spreads its snowy mantle over hedge and field, while the deep blue sky, and the sun rising in the glowing east, without a cloud, speak deceitfully of to-morrow's softness and beauty.

But notwithstanding the rigours of the climate, there are not wanting, even at the commencement of the season, interesting proofs of the advancing year, and harbingers of a more genial season. The day has already encroached on the long

and dreary night, and the sun takes daily a wider circuit in the heavens. The buds of many trees and flowers have begun to swell; the catkins of the hazel and willow throw their tiny but elegant forms on the sight. The anemonies are in flower in our gardens; and the crocus,

> ——— The first gilt thing
> That wears the trembling pearls of spring,

spreads its cloth of gold on the sheltered borders, along with the hepatica and the white butter-bur; and most interesting of all, the snow-drop, which had for weeks burst through the rigid soil, has now opened its chaste and delicate blossoms to the chilly breeze, and seems to vie in whiteness with the winding-sheet of winter, from which it derives its name.

> 'Already now the snow-drop dares appear,
> The first pale blossom of the unripened year;
> As Flora's breath, by some transforming power,
> Had changed an icicle into a flower;
> Its name and hue the scentless plant retains,
> And winter lingers in its icy veins.'*

Among the feathered tribes, the rooks are beginning to obey the first law of Nature, and their incessant notes of enjoyment, mingled with the bustle of preparation for the important duties of incubation, every where attract the attention of the lovers of Nature. The croaking raven, led by a congenial instinct, selects some venerable tree where she may build her nest, and the sweet songs of the woodlark and chaffinch, mixed with the mellow tones of the blackbird and thrush, from the neighbouring groves, delight the ear; while the wren, the red-breast, the titmouse, and the hedge-sparrow, flutter from spray to spray, and utter their varied notes of gladness, as the sun sheds his warmer rays on wood and field, giving the promise of approaching mildness and fertility. 'Turkey cocks now strut and gobble; partridges begin to pair; the house pigeon has young; field-crickets open their holes, and

* Mrs. Barbauld.

wood-owls hoot; gnats play about, and insects swarm under sunny hedges; the stone-curlew clamours, and frogs croak.'*

These indications are observed in Britain towards the end of February; and, as Spring advances, more unequivocal symptoms of awakening Nature daily appear. The sun continues longer above the horizon, and the weather, though still unsettled, is sufficiently dry to evaporate the superabundant moisture, poured on the earth at the commencement of the season in the form of rain or snow, and thus to favour the various processes of vegetable life which are in active operation, while it prepares the soil for the labours of the husbandman.

The animal tribes now find a delicious repast in the sweet and tender herbage, which begins to clothe our sheltered valleys with its soft verdure; and, among the innumerable sources of enjoyment which this most interesting of all the seasons affords, perhaps there is none that sheds so sweet a pleasure over the benevolent mind, as the universal gladness which, as the weather becomes more genial, sensibly pervades every thing that lives. There is a kind of mysterious sympathy which seems to pass from tribe to tribe of the animated world, and to unite them all in one common hymn of gratitude and praise to the bountiful Giver of all good. The lowing of the cattle as they luxuriate in the green fields; the bleating of the sheep from the heath-clad hills, while their new-dropt lambs sport around them, exulting in the consciousness of young existence; the hum of the industrious bees, as they fly from flower to flower collecting their sweet food; and the varied notes of love and joy, pouring from bush and brake, all unite in one harmonious and spirit-stirring chorus. Nay, inanimate Nature itself seems conscious of the general joy—and as the sun breaks forth from the April shower, every blade of grass sparkles in his beams, wood and mead smile, and the very silence of the clear heavens and swelling earth utters the voice of enjoyment.

* Howitt's Book of the Seasons.

The gradual progress of Spring indicates beneficent design. There is an obvious and studied preparation conducive to the salubrity both of animal and vegetable life. Were the change from winter to spring to be sudden, the constitution of organized existences, such as we find it in our own latitude, would receive so violent an impulse, as would be attended with many injurious consequences. There is here, therefore, a wise adaptation; but the proper way of viewing it is, not so much to consider the climate adapted to these existences, as them to the climate. There are necessarily great varieties of climates from the equator to the arctic circle, and, in them all, we discover a most admirable fitting of the produce and living inhabitants to the conditions of their respective localities; insomuch, that changes, which would utterly destroy the plants and animals of one climate, only tend to give vitality and health to those of another. For example, we have stated that fatal effects would ensue in our own climate, were the alteration from winter to spring to be sudden; and yet nothing can easily be conceived more rapid than the change of temperature from intense cold to genial warmth, in Siberia and other regions verging on the polar circle; and there the conditions of the animal and vegetable world are such, that the violent impulse is just what was required to bring them hastily into life, and enable them quickly to fulfil ther various functions, during their few and fleeting weeks of summer. In the whole economy of Nature, there is scarcely any thing more worthy of remark, as indicating a designing cause, than this species of adaptation, by which the powers of life are suited to the varying conditions of climate. There is, indeed, something extremely satisfactory, as well as peculiar, not only in this respect, but in the whole plan of creation, exhibiting as it does so much uniformity, combined with such variety,—a uniformity as to general design, which might even be supposed to indicate poverty of invention, were it not for the amazing skill with which that general design is modified and altered, so as to be rendered suitable to change of circumstances and conditions,—the former by its strict anal-

ogy, marking unequivocally One contriving Mind,—the latter by its endless variety, displaying the all-pervading wisdom and beneficence of unwearying energy and never exhausted resources.

FIRST WEEK—TUESDAY.

THE INCREASING TEMPERATURE OF THE WEATHER, AND ITS EFFECTS.

When we observe the earth gradually exchanging its winter robes for a mantle of the liveliest green, the flowers springing up in fresh luxuriance at our feet, and every shrub and tree putting forth its buds, which are soon to be beautifully expanded into blossoms and leaves, our first feelings are those of wonder and delight at the marvellous change produced in the general aspect of Nature; and we then naturally seek to contemplate the causes of such a universal transition. By what agency, we ask, does the vegetable world suddenly start from apparent death into all the beauty and exuberance of another spring? What cause, under the direction of the Great Ruler of the year, works the magnificent effect?

The means by which this sudden burst of vegetation is produced, are, like most of the other great agencies of Nature, extremely simple. It is merely the increased temperature of the earth and atmosphere, assisting the natural tendency of the plants to awake from the lethargic state into which they are thrown during winter. The progress of the earth in its orbit towards its aphelion, or greatest distance from the sun, causes that luminary to ascend higher in the heavens, and to be longer above the horizon, and thus produces longer and warmer days. It is a well-known physical fact, formerly noticed, that the more perpendicularly the sun's rays fall upon the surface of the earth, the greater is the heat they excite Hence, as the sun, in his northward progress in the ecliptic, daily ascends higher above the horizon, and consequently

darts his rays upon our hemisphere in a more perpendicular direction, the temperature of the earth and air gradually increases, and milder and more genial weather ensues. The effect upon the economy of vegetables is more or less rapid, according to their different structures; but in no long period the increased and increasing heat produces a universal development of foliage and flowers. The earth opens, as it were, her bosom to the sun; all her veins feel the genial influence; and a vital energy moves and works in all her blossoms, buds, and leaves. What was lately barrenness becomes fertility; from desolation and death start up life and varied beauty, as if beneath the reviving footsteps of a present Deity. Hence result all the beautiful and amazing phenomena of spring.

As it is a general property of heat to expand all bodies, so the fibrous and cellular substance, of which vegetables are mainly composed, is now subjected to a gradual expansion; and hence the sap ascends from the roots through the innumerable minute tubes and cells in the trunks and branches, and circulates through the finest veins of the leaves and flowers. There is a curious species of attraction, in virtue of which the sap of plants, and liquids in general, ascend through tubular substances, in seeming contradiction to the law of gravity. It is called *capillary* attraction, that is, the attraction of hairs, from the hair-like smallness of the tubes in which its effects are greatest and most visible. Its very remarkable phenomena are not yet satisfactorily accounted for; nor have its laws been fully investigated. It has been clearly ascertained, however, that the ascent of liquids is high in proportion to the fineness of the tubes through which they rise. Now, as the tubes of plants are perhaps the finest that exist, the effects of capillary attraction are more striking in trees than in any other substances; for in them the liquid juices frequently ascend to a height of more than a hundred feet, and circulate to the extremities of their largest branches and leaves.

It may be difficult to say how much of this process is

merely mechanical, and how much depends on that mysterious property,—the living principle; but there can be no doubt that heat, by promoting the ascent of the sap in plants, is the great external agent in vegetation. It increases in intensity by degrees; and its excessive accumulation is frequently checked by atmospheric changes. Herein is the highest designing wisdom. To recur to a remark yesterday incidentally made, were a summer temperature immediately to succeed the cold of winter, many of our plants would be greatly injured, if not totally destroyed. Their delicate vessels and cells would burst by a too sudden expansion, and the bud, prematurely thrust forth into the light and heat of day, would wither and fall off, or remain an abortive excrescence on its parent stem. We should also be deprived of the beauty and interest attached to the gradual development of leaf and flower, were the great annual transition in the vegetable world effected instantaneously.

In the average winter temperature of our climate, most of our shrubs and trees remain asleep, and without vegetation. But as, in the advancing season, the temperature increases, one plant after another, according to the sensibility of its buds, and other peculiarities of its structure, sends forth its tender shoots and leaves, in beautiful succession, till every field, and garden, and grove, is teeming with beauty and perfume. When once a plant has begun to put forth its foliage, and its vegetation has received a momentum, as it were, from the action of the solar heat, it will bear a temperature considerably below its *vegetating point*, without being much injured or wholly checked in its growth, provided that temperature be not of too long continuance. Here again is beneficent arrangement; for, were it otherwise with plants, we should frequently see the beauty of the forest and the field blasted by a single night's frost.

There is a striking analogy between the vegetative effects of the daily increasing temperature of this season, and the well-known influence of climate upon the geographical distribution of plants. From the first dawn of spring, before

the chillness of winter has left the air to the commencement or middle of autumn, when the year is beginning to wane, flower succeeds flower, and tree after tree comes into leaf, in regular succession. So, also, from the polar circle to the equator, race after race of vegetable forms appears, ascending from the lichens of Lapland to the spice trees of the Tropics. In our gardens, as the temperature of the atmosphere rises, come successively the snow-drop, the crocus, the auricula, the polyanthus, and, in their season, the rest of the splendid train of flowers. In the forest, the willow and the hazel bud earliest in the year; then follow the larch, the beech, the plane, the oak, and the ash; and soon all the sylvan scenery is one verdant mass of leaves. These pleasant successions have their parallels in each hemisphere. To take the northern, in which we dwell, we find in the remote arctic coasts of Europe and America, only mosses, lichens, ferns, and a few diminutive creeping plants and shrubs. As we advance southward, appear the various species of firs and pines, which, again, are closely succeeded by the oak, the elm, the lime, the beech, and other forest trees; and, among fruit trees, by the apple, the pear, the plum, and the cherry. More southward still, flourish the vine and the olive, the lemon, the fig, and the orange,—fruit trees of a richer and more delicate description; and, intermingling with these, grow the cyprus, the cork, the cedar, and the mulberry. Of cereal plants, wheat extends from the 60th degree of latitude to the neighbourhood of the tropics. Oats, barley, and rye, endure a greater degree of cold; but none of these are found to arrive at perfection within the tropics, except upon elevations several thousand feet above the level of the sea. Within the Torrid Zone, maize and rice begin to be cultivated. As we approach the equator, the vegetable productions of the earth increase in richness and luxuriance. In the tropical regions, we meet with the finest fruits and aromatics, and all the plants that most administer to the luxury of man. There flourish the sugar-cane, the coffee-tree, the bread-tree, the palm, the date, the cocoa, the cinnamon, the nutmeg, the pepper, the camphor-tree, and nu-

merous other vegetable treasures. Thus, between the arctic circle and the equator, we have every variety of vegetation, as in each of the intermediate regions there are, annually, beautiful successions of trees, shrubs, and flowers. And how can we withhold our admiration from the matchless skill of the Creator, when we consider that all the lovely variety of the phenomena of our spring, and all the benefits accruing to commerce and civilization, from the present varied distribution of plants, are made simply to depend on modifications of the solar heat? Hence, among other joyful recurrences, the sweet return of spring, and all the delights that intervene between the appearance of the earliest sprout and the full glories of summer vegetation; and hence the marvellous diversity of aspect, assumed by the vegetable world between the equator and the poles. What surprising, and beneficent, and varied effects! The cause, how grand and simple! But need we wonder at this, seeing it is but in accordance with all the operations of the Great Supreme. J. D.

FIRST WEEK—WEDNESDAY.

THE COLOUR AND FIGURE OF BODIES.

The admirable variety which we have seen to obtain over all Nature, may be said chiefly to consist of diversities in the colour, size, and figure of bodies. We have formerly adverted to the enjoyments and advantages that accrue from this variety; and here it may not be improper to dwell a little on the subject of colour and figure, the sources of so much utility and beauty. The term colour has two distinct significations. It may merely express that feeling of the mind which accompanies the sensation produced by any coloured object in our organs of sight; or it may denote the peculiar quality of that object, in virtue of which it excites in the mind a certain feeling, or perception of colour. Colour, however, is generally used in this latter meaning, expressing a particular quality of

bodies; and it is in this popular sense that we would here understand the term.

We cannot open our eyes, and cast an observant glance upon Nature, without being struck with the beautiful and varied phenomena of colour. The fields, the woods, the mountains, the sky, and the ocean, are tinged with a thousand different hues. Whence proceed all those splendid tints that give such variety and beauty to the drapery of Nature? Are they ideal creations of the mind? Do they exist merely in the eye?—or are they truly qualities of matter? To these questions the answer is, that, instead of being any of these exclusively, they result rather from a series of beautiful adaptations. First, every beam of light, as was discovered by Sir Isaac Newton, consists of seven distinct kinds of rays, all fitted to produce different colours; next, the surfaces of all bodies are so constituted, as to reflect one or other, all or none, of these classes of rays, or sometimes a mixture of several, or different proportions of them all; and, again, the eye is so exquisitely formed, as to be differently affected by the various kinds of reflected rays, and thus to be the faithful organ of the mind in discriminating between them, and thereby giving rise to all the delights of vision. The rays of colour, taking them in the order of their refrangibility, and beginning with the most refrangible, are violet, indigo, blue, green, yellow, orange, and red. One body absorbs all the rays but the green, which it reflects, and is consequently green. Another reflects the red rays, absorbing all the rest, and is red. An entire unrefracted beam is white; and when a body absorbs all the component rays, there is a negation of colour, that is, it is black. A body seldom reflects one of the prismatic colours solely and exclusively; but a greater or less proportion of another, or even of several, is commonly reflected along with it. In this way we can account for the endless diversity of hues that result from the seven primary colours; for the proportions in which the several rays may be reflected together are indefinitely numerous. We can only conjecture the cause of bodies reflecting one class of rays, and absorbing

others, so as to appear to our eye of a certain colour. It probably consists in a peculiar arrangement of their minute particles. This arrangement may be destroyed by mechanical or chemical agency, which will account for the changes of colour in bodies exposed to the weather, or to any chemical action. The process of dyeing is only the spreading over the surface of one body the particles of another of a different colour, which, however, can scarcely be effected without producing some chemical change in the dyed substance. The rays of light which, in solid bodies, hardly penetrate the surface, are reflected or absorbed by the dyeing matter, and the original colour of the body is consequently lost.

Colours are spread over all Nature with exquisite beauty and adaptation. The earth is clothed with a mantle of delightful green, interspersed with the more brilliant hues of shrubs, trees, and flowers. In point of refrangibility, green holds the middle place between the two extremes of violet and red. Neither too dark nor too bright, on it the eye, when wearied with livelier or more sombre colours, delights to repose. Were the earth's surface of a black colour, it would be distressing even to look upon, as the eye and mind are at present constituted. Or were white the prevailing hue, our eyes would be dazzled with excessive brightness, and would turn away from all objects with pain and weariness. The colour of the sky is a deep blue, contrasting pleasingly with the soft green of the earth. The blueness of the sky may be caused by the particles of air, and the minute globules of moisture, constantly floating among them, reflecting the blue rays; or it may result from the circumstance, that, of all the rays reflected from the earth into the atmosphere, the blue being most refracted, have the least momentum, and are consequently more liable to be reflected back to the eye. Nor is variety of hue wanting in the regions of the air. Clouds of almost all colours and varieties of tinge, frequently move before the delighted eye, like the splendid scenes of a vast theatre. The sparkling lustre of universal sunshine, the lurid glare of the thunder-cloud, the crimson streaks of

morning, and the rich and ever-varying glories of sun-set, successively solicit our admiration and delight. Yet the eye would tire even of these, if of continual occurrence; and hence the prevailing hue which has been chosen is the pure azure of the unclouded atmosphere, or the sombre shade of the rain-cloud.

The colour of the ocean varies considerably with local circumstances. Its generic colour is dark blue, but in different places it is green, red, or yellow. Various causes may be assigned for the discoloration of the oceanic waters. The nature of the bottom, the weeds and insects upon the surface, the substances and solutions discharged into them by large rivers, all contribute to affect their colour. But the prevailing hues of the ocean are dark and cool, which are at once pleasant and refreshing to the eye, even when accustomed to them, during the months of a long voyage. Yet the ocean is often strewn with wreaths of foam, and has its vast billows crested with white, and rolling in dreadful beauty to the shore. And the foamy whiteness of its agitation is not without its use, independent of its variety and grandeur; for it points out to the voyager the existence of danger, warns him of the approaching storm, and discovers to his distant eye the hidden reef or shoal, and the breakers of a rocky coast.

The variety of Nature depends still more upon the figure of bodies than upon their colour. Figure is an essential property of matter. All bodies, and even the elementary particles of which common substances—the familiar objects of sight and touch—are composed, must, from their very nature, be extended in space, and possess length, breadth, and thickness, which have been termed the limits of extension. We can scarcely conceive of bodies as masses of matter extended in space, without also thinking of their property of figure; because figure is the inevitable result of limited extension, and may, indeed, be defined to be the shape or appearance any body presents from its occupying a certain quantity of space in certain directions.

Figure is almost as varied as the productions and pheno-

mena of Nature are numerous. In the vast and in the minute world, its diversity is equally striking and apparent. We can conceive no bounds to its diversity, which, in reality, is as nfinite as number or quantity. The forms which matter has assumed upon our globe, defy computation; and how shall we pretend to estimate, or even to conceive, what forms it is capable of assuming?

Figure is either symmetrical or irregular. In the productions of Nature there is usually a symmetry and regularity of form, which can hardly escape the most unpractised eye. Who does not observe, or, observing, is insensible to, the effect of the graceful curved lines that prevail in the animal and vegetable worlds, or of the symmetrical angular forms assumed by minerals and crystals? The property of figure in bodies is the source of half the pleasure we enjoy in our intercourse with Nature. It is of itself a fountain of beauty. It equally seizes the attention of the lover of scenery and the naturalist; is as efficient in exciting pleasing emotions when perceived in the harmonious and beautiful landscape, in the rain-cloud, the hail, the dew, or the snow, as in the graceful form of a flower, or the wreathings of a shell.

It is a curious subject of reflection, that, however great may be the diversity of figure at present existing among solid bodies, yet, in certain specifiable circumstances, they would all assume a globular form. When we contemplate the visible universe, we discover it to consist of an innumerable collection of spheres; and what is true of the suns and satellites that adorn the firmament, has also been proved true of our earth. We know, therefore, the forms which the vast bodies that fill the infinitude of space have assumed, on being hurled from the hand of their Creator. But we also know what form a body would assume in empty space, provided only the cohesive attraction of its component particles were so subdued as to allow gravitation to act freely. It is more than probable that all solids might be reduced to a liquid state. Their cohesion has only to be overcome by heat to a certain extent, and they become fluids. Now, fluids, as they fall through

space, are invariably transformed into globules. The phenomena of rain, and of molten lead let fall from a height, are well known instances of this, and require no description.

Difference of size is another element of the variety of Nature. The distinction between size and figure is natural and obvious. If bodies of the same figure be of different sizes, all the effect of variety is produced. The variety of the heavenly bodies, for example, as seen from the earth, is chiefly that of size. Size, or magnitude, it is evident, is only relative. One body may be large in relation to another, but insignificantly small in relation to a third. What is the loftiest mountain-peak compared to the earth, and the earth compared to the sun? Yet that peak is a world relatively to a grain of its sand. In Nature we see an infinite diversity of the magnitudes of bodies, from the sun, that is the centre and life of numerous worlds, down to the mote that flickers in one of his beams. And when, setting out from the opposite extremes of magnitude that come within the reach of our perception, we attempt to measure its ascending and its descending scale, and to find a limit to the vast and the minute, we utterly fail in our efforts; and even imagination itself is overpowered. So illimitable in both directions is the universe of God.

Thus, whatever is the property of material substances, be it essential or merely contingent, that comes under our observation, we find in it Divine benevolence and wisdom. The colours, figures, and sizes of bodies are infinitely varied, and thereby is the earth agreeably diversified and adorned.

J. D.

FIRST WEEK—THURSDAY.

MOUNTAINS.

Few objects in Nature have a sublimer aspect than a chain of lofty mountains before they have recovered from the effects of wintry storms. Disrobed of their summer verdure, and

lifting their bare summits in the chi' air, or clad in a mantle of drifted snow, they seem to be the chosen haunts of desolation, the wild abode of darkness and storm. Crowned with no ancient forests, and unadorned with human dwellings, unfurrowed by the plough, incapable of cultivation, and but scantily clothed with a poor and stunted herbage, these vast eminences might at first sight appear almost useless features in the general landscape,—not without their majesty and grandeur, indeed, in the day of storm or of sunshine, yet unprofitably encroaching upon the beauty and fertility of the plain.

But experience and research have unfolded to us the great advantages of mountains. Were it only because they are the sources of springs and rivers, we have ample reason to feel grateful for their existence. Their vast masses attract the clouds, and receive, in the form of rain, hail, or snow, the vapours with which the atmosphere is charged, even when the plains below are parched with summer drought; and hence the irregular and mountainous surface of the earth is veined over with a multitude of rills, and brooks, and rivers, whose waters, by a wonderful species of circulation, flow to the place whence they came,—that mighty and ever-heaving heart, the ocean. Were the earth a dead level, or even slightly varied with hillocks or gentle ascents, the moisture that should fall would be gathered into turbid and sluggish streams, or stagnant lakes, and the whole surface of the ground, more than saturated, would become a vast marsh, sending forth noxious exhalations, pregnant with disease and death. All animal and vegetable life would languish; cultivation could scarcely exist; and, instead of a scene of rich and varied beauty, we should only behold a cheerless mixture of land and water. All the advantages attributed to rivers, might with greater propriety be ascribed to the mountains that produce and nourish them. Let us take one example of a mighty and fertilizing river, the Nile. Whence flow those famous waters, that, after a long and mysterious course, scatter golden harvests over the vale of Egypt? They descend from the Abyssinian

and Nubian mountains, and are fed by their melted snows, and by the abundant tropical rains. Their remotest springs may be yet undiscovered, but these also are doubtless formed in the bosom of the Ethiopic hills.

Mountains exercise a considerable, and, upon the whole, a salutary influence upon climate. Independently of the effect of the streams and rivers which they originate and send forth, to promote at once the fertility and salubrity of the champaign country, these elevated ranges, by intercepting the clouds, or by changing the currents of wind, so as to cause them to mingle, generally occasion that deposition of moisture, which, in its different forms, is called mist or rain, and which is so necessary to water the earth, and make it fruitful. We are screened from cold northerly blasts and from parching winds, by mountains, the bulwarks Nature has reared to shield her valleys and plains. In countries near the poles, their presence affords a protection from the cold; and in the tropical regions they mitigate the solar heat, or afford a shelter from its influence. They form one of the many great arrangements made to equalize the temperature of the earth's various climates. In their southern slopes, we find on the grandest scale bright sunny exposures, on which, even in the higher latitudes, flourish the grape, the olive, and other delicious fruits. On mountains, also, we frequently find all the climates of the earth, varying according to the elevation, and the consequent rarity and coldness of the air. In the lofty tropical ranges, every clime, with its peculiar productions, is met with, between the burning plains at their basis, and their summits capped with eternal snow. Thus, the Alps, the Andes, and the Himmalayahs, present every variety of stern and luxuriant scenery, and, though rising in the regions of perpetual summer, bear on their summits the plants and flowers of the polar circles. The number of valuable simples found only on mountains, also recommend to our gratitude these vast terraces of Nature. In the extensive forests that frequently enrobe them, or on their bare rocks unshielded

from the chilling air, grow the rarest and most useful vegetables, botanical curiosities, or of medicinal virtue.

Mountains are likewise almost the sole repositories of minerals. In their cavernous bowels are discovered the various metals that are so invaluable to man, and so necessary to the arts of civilization.* The grains of gold sometimes found in the sand of rivers, are but stray treasures, rolled down from their native hills. These great mineral storehouses are sometimes up-torn by subterranean fires, and burst forth into terrible volcanoes. But may not the volcano, destructive and awful as it frequently is, be but a safety-valve for the escape of those sulphurous and nitrous fires generated in the shell of the earth; and which, if they found not vent through the chimneys and furnaces of mountain-peaks, might so accumulate in quantity and force, as to tear up and consume entire kingdoms? The innumerable particles of sulphur and nitre, evolved from volcanic fires, are scattered by the winds over the whole atmosphere, and fall upon the earth, where

* 'Had the earth's surface presented only one unvaried mass of granite or lava, or had its nucleus been surrounded by concentric coverings of stratified rocks, like the coats of an onion, a single stratum only would have been accessible to its inhabitants; and the varied intermixtures of limestone, clay, and sandstone, which, under the actual disposition, are so advantageous to the fertility, beauty, and habitability of the globe, would have had no place.

'Again, the inestimably precious treasures of mineral salt and coal, and of metallic ores, confined, as these latter chiefly are, to the older series of formations, would, under the more simple arrangement of strata, have been wholly inaccessible, and we should have been destitute of all these essential elements of industry and civilization. Under the existing disposition, all the various combinations of strata, with their valuable contents, whether produced by the agency of fire, or by mechanical or chemical deposition beneath the water, have been raised above the sea, to form the mountains and the plains of the present earth: and have still further been laid open to our reach, by the exposure of each stratum, along the sides of valleys.

'With a view to human uses, the production of a soil fitted for agriculture, and the general dispersion of metals, more especially of that most important metal, iron, were almost essential conditions of the earth's habitability by civilized man.'—*Buckland's Bridgewater Treatise*, vol. i. p. 98.

they contribute greatly to the sustenance of plants and animals.

Need I speak of the scenic grandeur of mountains? of the variety, the sublimity, the lofty beauty they throw over the earth's surface, which, but for their presence, would be a dull and undiversified plain? The ocean is not always calm and smooth, but has its mighty billows, ascending to the clouds and rolling to the distant shore; so the land is not a continued and uniform level, but is crowned and beautified with mountains, that stretch over continents their longitudinous arms, and lift their hardy tenants into the higher regions of the air. No landscape is perfect without mountains in the fore-ground, or in perspective. They form the noblest and most enchanting attribute of scenery.

The *moral* effects of mountains are of a peculiar, and even national, interest. Mountains have in all ages been the nurseries of patriotism, the abodes of industry, frugality, patience, and every hardy virtue. The rugged mountaineer, buffeted, but fostered and strengthened, by the storm, and gaining a scanty subsistence as a hunter, or as a tiller of the bleak and rocky soil, is not only a striking and picturesque personage in the eye of the painter or the poet; but, when his country summons her children to battle, or when foreign invasion threatens his dwelling, his heart is bold and his arm is strong in the cause of freedom and independence. Often, in the front of the fight, have mountaineers won pre-eminence in warlike prowess; often, from their native precipices, have they hurled defiance and defeat on the invading foe. Mountain chains, possessed and guarded by their bold inhabitants, are the best barriers against external danger, and the securest asylum of persecuted freedom. And frequently, in the history of the Church, have the afflicted followers of the Saviour found refuge in mountain tracts, where, in wild dens and caves of the earth, they have worshipped the God of their fathers, concealed from the tyrant and the oppressor.

Mountains may impede our rapid progress from place to place, and throw great obstacles in the way of our inland

conveyance; but the more we consider their structure and functions, the more forcibly are we impressed with their peculiar uses and advantages. Here, again, are we called upon to admire the unfathomable wisdom and power of the Creator, whose contriving hand has so wonderfully adapted even the barren mountain to the physical condition of the earth, and the exigencies of man. The solid land, and the restless ocean, with all their variety of aspect and scenery proclaim His goodness. His praise ascends from the naked precipice as well as the smiling valley. All is replete with the wisdom and energy of Him who founded the earth, and 'stretched out the heavens like a curtain,' who weighed the 'mountains in scales, and the hills in a balance.'

J. D.

FIRST WEEK—FRIDAY.

RAIN.

Among the various analogies of Nature, so curious and so diversified, may be ranked that of the circulation of fluid substances. The blood circulates in animals, the sap in plants, and, on a larger scale, the air and the waters of the vast ocean circulate between the equator and the poles, while another species of circulation is created by the combined action of these two elements, which is exhibited in the various phenomena of clouds and rain, and of springs and rivers.

The earth is surrounded with an atmosphere of air, and into this another atmosphere, namely, that of water, in the form of vapour, is introduced by evaporation. These two atmospheres are mingled together in such proportions, that the aerial part always greatly exceeds the aqueous,—the latter varying in weight from about a hundredth, perhaps to a twentieth part of the former. Mr. Whewell, in his Bridgewater Treatise, has very ingeniously shown, that the different laws by which these two fluids are regulated, though, on account

of the complicated nature of their relations, their effects cannot always be distinctly traced, are yet such as can be demonstrated, in various particulars, to manifest the most remarkable proofs of wise arrangement, the one modifying and adjusting the other, so as to contribute to the subsistence of vegetable, and the enjoyment of animal, life. It is not consistent with our plan to go deeply into this subject; but the general view taken in the work alluded to, and by other writers on natural phenomena, may be mentioned in a few words. Were the atmosphere to consist entirely of aqueous vapour, the difference of heat in various latitudes, from the equator to the poles, would cause the vapour generated in the former regions to be more rare and elastic than that produced in the latter and intermediate climates; and this difference would create a constant circulation between these extreme points. The sky of the equatorial zone would be perpetually cloudless; but in all other latitudes we should, from the intermixing of the warm with the cold vapour, have 'an uninterrupted shroud of clouds, fogs, rains, and, near the poles, a continual fall of snow,'—'an excessive circulation of moisture, but no sunshine, and, probably, only minute changes in the intensity and appearances of one eternal drizzle or shower.' This state of things would plainly be altogether unfavourable to vegetable and animal life; but the addition of an aerial atmosphere changes the condition, and by its agreement with the atmosphere of vapour in some particulars, and its disagreement, and even direct opposition, in others, so regulates and modifies the whole machinery of the weather, as to render it salubrious. 'The alternations of fair weather and showers, appear to be much more favourable to vegetable and animal life, than any uniform course of weather could have been. To produce this variety, we have two antagonist forces, by the struggle of which such changes occur. Steam and air, two transparent and elastic fluids, expansible by heat, are in many respects and properties very like each other. Yet the same heat, similarly applied to the globe, produces at the surface, currents of these fluids, tending in opposite directions. And these cur-

rents mix and balance, conspire and interfere, so that our trees and fields have alternately water and sunshine, our fruits and grain are successively developed and matured. Why should such laws of heat and elastic fluid so obtain, and be so combined? Is it not in order that they may be fit for such offices? There is here an arrangement which no chance could have produced. The details of this apparatus may be beyond our power of tracing; its springs may be out of sight. Such circumstances do not make it the less a curious and beautiful contrivance. They need not prevent our recognizing the skill and benevolence which we *can* discover.'*

But besides the difference of heat and cold in different latitudes, there is a similar variation in the higher and lower strata of the atmosphere in the very same localities. The air becomes rapidly colder, as well as lighter, in proportion to its height above the general surface of the earth; and this gives rise to other phenomena. The temperature of the air, as it increases in altitude, diminishes much more rapidly than that of vapour; and the result is, that the evaporated moisture has a constant tendency to ascend into the higher regions, which prevents the air at the surface from being saturated, and keeps up the evaporating process, while the warmer steam, mingling as it ascends with that which is already floating in equilibrium in the upper regions, occasions a precipitation,—and hence the various phenomena of clouds, mist, and rain. These phenomena, again, are modified by the circumstances previously described; and the various currents of warm and cold air, occasioned by many different causes, combined in numerous ways and in divers degrees, give rise to all the varieties of sunshine and cloud, moisture and drought, to which we apply the name of weather, and, by the due balance of which, the fertility of the different regions of the earth is secured.

Such is the general nature of the wonderful mechanism of the atmosphere, so wisely and so bountifully adapted to the

* Whewell's Bridgewater Treatise, p. 101.

organized existences produced by the soil. But there are other particulars, also, which must not be forgotten. Among these, the provision by which the rain is made to fall softly on the earth, and to be diffused in due proportions over its surface, is peculiarly worthy of notice. When we think of the vast quantities of water continually floating over our heads, and at the same time reflect on the irregular and apparently capricious motions of the atmosphere, there seems, at first sight, to be much that is calculated to fill us with alarm. Could we suppose an intelligent being to drop on our globe, and to be made acquainted with just so much of the powers which regulate the antagonist forces of steam and air in our atmosphere, as philosophy has discovered, and no more, while he remained ignorant of the manner in which these powers practically operate,—a kind of knowledge which we learn from experience,—what would be his conclusion? Let him be told that there is an amazing accumulation of moisture floating above the surface of the earth, and having a continual tendency, within certain bounds, to increase; but there are currents of air, sometimes breathing softly, sometimes driving furiously, sometimes expanding this moisture by its heat, sometimes suddenly precipitating it by its cold, sometimes dispersing it far and wide, sometimes strongly compressing it by pouring from opposite quarters. He would immediately say, if all this is not regulated by some other principle than appears—by some over-ruling Intelligence—there must necessarily be the most destructive inequalities in its distribution over the surface of the earth. It will fall sheer down in some places in one unbroken sheet, so as to overwhelm whole continents with a sudden and fatal deluge, while in other situations, an entire destitution of moisture will prove equally fatal to organic life. There is here no equilibrium,—no compensating nor equalizing principle, so far as can be observed. The elements in action, and the forces employed, are so opposite and so powerful, that nothing but confusion and ruin can be the result.

Such is the legitimate conclusion which a rational being

might form, without the aid of experience or the knowledge of a superintending Providence. But how different is the reality! The various phenomena of the weather, though irregular, and apparently capricious, when viewed from day to day, are yet preserved within salutary bounds, and wonderfully exhibit, in a series of weeks or months, a certain specific average, in a given locality, which is favourable for producing and nourishing the fruits of the earth. The cold or the heat, the sunshine or the gloom, may be longer protracted at one period than at another, but they are seldom carried to such an extreme as to prove injurious. The rain may sometimes fall in torrents, and occasional inundations may be the consequence; but such occurrences are rare exceptions from a beneficent rule. The moisture is generally distilled from the clouds in gentle and fertilizing drops, at such seasons, and in such quantities, as are best calculated for cherishing the peculiar vegetation of the regions where it falls. All these circumstances are obviously adjusted to the qualities of the soil, and of the vegetable principle, so as to give scope to the powers of life inherent in nature, and to spread abundance and enjoyment over the earth.

Here, then, we have a new proof of designing wisdom and diffusive goodness,—the more admirable, as it is entirely in harmony with the character of the rest of the Creator's sublunary works. We do not find a system free from imperfection, and unmingled with evil; but we see tremendous and destructive forces controlled and regulated with consummate skill, so as to harmonize with the other powers and conditions of the physical world, while these, again, equally harmonize with the circumstances of the moral world,—thus forming one amazing but mysterious whole. And when we turn from this aspect of Nature, to that of Revelation, and compare them together, we here, above all, are presented with arguments, analogies, and accommodations, which at once astonish and delight, confound and satisfy, the inquiring mind.

FIRST WEEK—SATURDAY.

SPRINGS.

WATER is not only essential to the growth of plants, but to the subsistence of animals. There is, however, this difference in the wants of these two orders of organized beings, that, whereas plants require only occasional supplies of this fluid, at considerable intervals, and are most luxuriant when, at particular seasons of the year, rainy weather is followed by uninterrupted sunshine, for several days or even weeks in succession, few living creatures can subsist without the daily use of water. Were the earth, therefore, only to receive moisture directly from the clouds in the form of rain, and under present conditions, vegetation indeed would subsist and flourish, but the animal world would soon become extinct. The provision by which this essential want is supplied, is that of fountains and springs of running water.

There is something very peculiar in the circumstances connected with this provision, which cannot fail to interest the contemplative mind. Mountains have already been stated as the general reservoirs from which springs derive their supplies; and, considered in this light, the peculiar form of the earth's surface, in which mountain ranges and elevated ground alternate with long extended valleys and champaign country, cannot but be considered as a beautiful provision of Divine intelligence. But there is something peculiar in the structure of the substances of which hills are usually composed, which is also obviously calculated to favour the existence of springs. They consist, generally, of stratified rocks, and, in many of the lower elevations, of gravel, through which the moisture passes readily, alternating with beds of clay or marl, where it is arrested in its downward progress, and forced by its natural tendency to seek for a vent in the open air; or, where the rocks are primitive, and are, therefore, generally, less permeable by water, there are fissures and hollows through

which the fluid sinks, and in which it is deposited, gradually accumulating till it finds egress in a running stream. In stratified districts this egress is frequently facilitated by what miners and geologists call *faults*, that is, breaks in the continuity of the rocks.*

The benevolent intention of this arrangement, is too evident to escape observation. Were there not beds of clay in the one case to intercept the water as it sinks, and fissures and openings in the other, in which it is received and accumulated, the earth would, by reason of an irregular supply of this necessary element, be rendered unfit for the subsistence of living creatures, and all the wonderful apparatus of vegetation which Providence has provided for their use, would have been spread over its surface in vain. There would have been neither fountain nor river, and the whole earth would have been reduced to the state of the inhospitable Steppes of Russia, where, on account of the absence of mountains and springs, there exists a vast extent of soil, often naturally fertile, but, except where the waters of distant regions sluggishly meander, or are collected in lakes and pools, unfit for the support of animal life.

There is yet another circumstance, at once curious and important, connected with the geological structure of the earth, as regards a supply of water, which I must not omit to mention, more especially as it illustrates, in a striking manner, a very remarkable feature in the arrangements of the Creator with reference to His rational creatures, to which I have already had occasion, in the preceding volume, more than once to advert, and of which the provisions connected with the agricultural operations of the present season, will again and again forcibly remind us,—I allude to the fact, that however

* It is stated by Mr. Hopkins, that all the great springs in the limestone districts of Derbyshire, are found in conjunction with great faults.—'I do not recollect,' says he, 'a single exception to this rule, for, I believe, in every instance where I observed a powerful spring, I had independent existence of a great fault.'—*Philosophical Magazine, August* 1831, p. 131, *quoted by Dr. Buckland.*

bountiful may be the contrivances for the subsistence of organized existences which are naturally in actual operation, there are everywhere, latent and in reserve, many more, the discovery and application of which have been left to the ingenuity of civilized man; thus calling forth and rewarding his intellectual powers and active exertions, and laying the foundation for unlimited improvement in the arts and sciences. The circumstance which at present gives rise to this observation, is the discovery of what are called Artesian Wells, by which is meant, "perpetually flowing artificial fountains, obtained by boring a small hole through strata that are destitute of water, into lower sheets of this important fluid, which ascends by hydrostatic pressure, through pipes let down to conduct it to the surface."

There are numerous instances of this application of human skill to the supply of what was a desideratum in particular localities, both in this country and on the continent. The word is derived from the district of Artois (the ancient Artesium), where the want of natural springs has, for a long period, induced the inhabitants to apply to this most effectual resource. The quantity of water thus obtained in Artois, is often sufficient to turn the wheels of corn-mills. The following is an abstract of the account given by Dr. Buckland of this remarkable method of extracting a supply of water from the bowels of the earth:—'It appears that there are extensive districts in various parts of Europe, where, under certain conditions of geological structure, and at certain levels, artificial fountains will rise to the surface of strata which throw out no natural springs, and will afford abundant supplies of water for agricultural and domestic purposes, and sometimes even for moving machinery. In the Tertiary Basin of Perpignan, and the Chalk of Tours, there are almost subterranean rivers having enormous upward pressure. The water of an Artesian well in Roussillon, rises from thirty to fifty feet above the surface. At Perpignan and Tours, M. Arago states, that the water rushes up with so much force, that a cannon-ball, placed in the pipe of an Artesian well, is violent-

ly ejected by the ascending stream. In some places application has been made to economical purposes of the higher temperature of the water rising from great depths. In Wurtemberg, Van Bruckmann has applied the warm water of Artesian wells to heat a paper manufactory at Heilbraner, and to prevent the freezing of common water around his mill-wheels. The same practice is also adopted in Alsace, and at Cronstadt, near Stutgard. It has even been proposed to apply the heat of ascending springs to the warming of green-houses. By means of similar wells, it is probable, that water may be raised to the surface of many parts of the sandy deserts of Africa and Asia; and it has been in contemplation to construct a series of these wells along the main road which crosses the Isthmus of Suez.'*

Various other particulars might be mentioned; but I must dismiss the curious subject with this single additional observation, that by the judicious use of these hidden stores, thus providentially laid up, it may yet be in reserve for the ingenuity of man, materially to extend the boundaries of the habitable parts of the earth; bringing water, not miraculously, indeed, as Moses did, but by use of the rational powers with which he is endowed, out of the cleft rock, to cheer the barren wilderness, and to cause 'the desert to blossom like the rose.'

The geological arrangements which we have mentioned, correspond with, and are obviously intended to carry into effect, the beneficent contrivances belonging to the atmosphere. Fresh water evaporated from the salt sea, is held in solution in the air, and borne by currents over the face of the earth, which it moistens and renders fertile, as it passes along, being condensed into clouds, and precipitated in rain. What is redundant, after performing this useful office, flows off by means of springs, uniting into brooks, and then into rivers, which preserving life and diffusing fertility wherever they glide, complete the wonderful circulation of the fluid, by returning to the parent ocean; and thus, while they preserve

* Buckland's Bridgewater Treatise, vol. i. pp. 565–568

the balance of the sea and land, afford an additional instance of the wonderful analogies which pervade Nature.

Metastasio, in a passage of his dramatic works, has, with great beauty and poetic feeling, employed this tendency of water to find its way back to its original source, in shadowing forth the love that an affectionate heart bears to its native home—which has been thus elegantly translated by Dr. Beattie. I quote from memory:—

'Rivers from the ocean borne,
Lave the valley and the hill,
Prisoned in the fountain, mourn—
Murmur in the winding-rill.

Still wherever doomed to stray,
Still they warble and complain;
Still pursue their devious way,
Till they reach their native main.

After many a year of woe,
Many a long, long wandering past
Where at first they learned to flow,
There they hope to rest at last.'*

As the hills are the destined origin of springs and rivers, a remarkable provision is made for the supply of such natural reservoirs, by a far more abundant fall of rain in these elevated situations than on the lower grounds. The amount of this difference is much greater than is generally supposed, as

* The original is from the drama of Artaxerxes. It is still more soft and tender, and expressed in fewer and simpler words:—

'L'onda del mar divisa
Bagna le valle, e'l monte
Va passeggiera
In flume,
Va prigioniera
In fonte,
Mormora sempre, e geme
Fin che non torna al mar.
Al mar, dov'ella nacque,
Dove acquisito gli umori,
Dove da' lunghi errori,
Spera di riposar.'

has been proved by various experiments, and may be illustrated by the following, which is stated in the Supplement to the Encyclopædia Britannica, under the article Meteorology. In the neighbourhood of Kinfauns Castle, a rain-gage is placed on the summit of a hill six hundred feet above the level of the sea, and another in the garden at the base of the hill, about twenty feet above the same level. The mean annual result of the quantities which fell in each of the situations, on an average of five years, was, for the hill gage, 41.49—and, for the garden gage, 25.66, a difference which would lead to the conclusion, that the quantity of rain which falls on mountain ranges is nearly double that which waters the valleys. There can, at all events, be no doubt that the difference is great, arising chiefly from the well-known property of hills, by which they attract the clouds, and, extracting the electric fluid, dissolve them in showers.

Supposing, therefore, what has been alleged, that the quantity of evaporation which takes place from the surface of the earth, is not greatly inferior in quantity to the rain that falls upon the low grounds, and that, therefore, there would not, from this source, after the necessary supply of vegetation, be much surplus to return to the sea, yet the additional falls of rain on the hills seem amply sufficient to account for the innumerable rills and streams which intersect the land in all directions. Mr. Dalton has calculated, that the quantity of water annually discharged into the sea by all the rivers in England and Wales, does not amount to more than thirteen inches over the whole surface; and it is stated by M. Arago, that one-third only of the water which falls in rain, within the basin of the Seine, flows by that river into the sea. The remaining two-thirds either return into the atmosphere by evaporation, or go to the support of organized existences, or find their way into the sea by subterranean passages.

I cannot better conclude this paper, than in the words of the eminent Professor whom I have partly followed in the facts on which its reasoning is founded.—'In the whole machinery of springs and rivers, and in the apparatus that is

kept in action for their duration, through the instrumentality of a system of curiously constructed hills and valleys, receiving their supply *occasionally* from the rains of heaven, and treasuring it up in their everlasting storehouses, to be dispersed *perpetually*, by thousands of never-failing fountains, we see a provision not less striking than it is important. So, also, in the adjustment of the relative quantities of sea and land, in such due proportions as to supply the earth by constant evaporation, without diminishing the waters of the ocean; and in the appointment of the atmosphere to be the vehicle of this wonderful and unceasing circulation, and thus separating these waters from their native salt (which, though of the highest utility to preserve the purity of the sea, renders them unfit for the support of terrestrial animals and vegetables), and transmitting them in genial showers to scatter fertility over the earth, and maintain the never-failing reservoirs of those springs and rivers by which they are again returned to mix with their parent ocean; in all these circumstances we find such evidence of nicely balanced adaptation of means to ends, of wise foresight, and benevolent intention, and infinite power, that he must be blind indeed, who refuses to recognize in them proofs of the most exalted attributes of the Creator.'*

SECOND WEEK—SUNDAY.

ADVANTAGES OF VICISSITUDE.

When the earliest snow-drop pierces the dark earth, like morning springing out of night, and gives promise of the coming genial season, the impatient spirit hails the tender harbinger, and already in anticipation revels in vernal delights. But many a pinching frost, and many a splashy thaw,

* Buckland's Inaugural Lecture, p. 13. See also the same author's Bridgewater Treatise, chap. xxii.

and many a shower of sleet, must be endured before winter will 'sound his trumpet in the blast, and call his storms away.' And many a fair and promising bud must be checked in its efforts to struggle into life, beneath the incongruous alternations of cold and sunshine. Yet the sunbeam which bids the sap ascend, and summons the bud into existence, is not more salutary, or more necessary for the security of the future fruit, than is the storm which repels its too hasty growth, and seems to threaten its destruction. Variety seems the very essence of health and vigour in the natural world, as it is in the moral. Who could endure the tedious sameness of skies ever blue, a sun ever shining, earth ever green, and streams ever gliding in tranquil brightness? The very deliciousness of Nature's beauties would, after a time, render them nauseous. The weary eye would long for the interposing canopy of clouds, and the friendly return of evening. A patch of wilderness and moorland would be hailed with joy; and flood and rock enough to form a cataract, might serve to chase the *tedium vitæ*, which would otherwise steal upon us. The mind is not allowed to stagnate in one train of contemplations, by the uniformity of surrounding objects, any more than its dwelling-place the body, is allowed to become listless and enervated by the sameness of its sensations. We learn to appreciate our comforts by means of occasional privations, and find reason to adore the majesty and grace of the beneficent Being, who not only smiles in the sun-beam, but frowns in the storm.

'Yesterday the sullen year,
Saw the snowy whirlwind fly,
Mute was the music of the air,
The herd stood drooping by.

* * * *

The hues of bliss more brightly glow,
Chastised by sabler tints of woe;
And, blended, form with artful strife,
The strength and harmony of life.

See the wretch that long has toss'd,
On the thorny bed of pain;

At length repair his vigour lost,
And breathe and walk again.

The meanest flow'ret of the vale,
The simplest note that swells the gale,
The common sun, the air, the skies,
To him are opening paradise.'*

So says the poet, with equal beauty and correctness. Every enjoyment is enhanced by privation; and our necessity of change is a strong evidence of our infirmity, and of the transition state in which we are placed. The Hindoo devotee, who has clenched his fingers till the nails have protruded themselves from the back of his hands, or drawn up a limb, and retained it in one position till its contracted sinews no longer suffer him to wield it, gives evidence that absolute rest was not made for man. However sweet repose may be to a weary pilgrim, beyond a certain point repose itself will become a weariness. The hungry cannot always feed, or the thirsty drink for ever. 'Man and for ever!' once exclaimed a statesman, in a fine burst of irony,—'Man and for ever!'—Most truly an idle combination,—a contradiction in terms as relates to his sublunary state. Yet man exhibits his unconscious longing after immortality, by his propensity to use terms inapplicable to his present condition. If he loves, he will love *for ever:* If he is grateful, he will *never* forget: If he forms a friendship, it is to be *eternal.* We talk of *for ever*, yet there is nothing perpetual but change; and our ease and enjoyment in this fleeting scene depend on that perpetuity of change.

There is but One who is always of one mind, whose purposes stand fast, and all whose actings are uniform. The wisest of men turned his weary eye from the contemplation of that which he found to be vanity and vexation of spirit, and fixed his confidence on this One. 'I know,' says he, 'that whatsoever God doeth, it shall be for ever; nothing can be put to it, nor any thing be taken from it, and God doeth it, that men should fear before him.' It is this great Artificer,

* Gray's Ode to Vicissitude.

then, who operates upon the changeful human being; and that which forms our variety, and our vicissitude, is but the recurrence of the same effects from the same causes, altered only by new combinations; it is the repetition of the same unchanging laws, which are without variableness in the hand of Him who formed them. Fitly, therefore, is our lot placed in His hand; and while his beneficent contrivance has rendered vicissitude delightful, a much more weighty object is attained under its influence than merely enhancing felicity, or adding pungency to enjoyment.

He who knoweth what is in man, sees the necessity of 'emptying us from vessel to vessel,' as the prophet strikingly remarks, using the figure of one preparing wine, whose purpose is, by each outpouring of the liquor, to leave a portion of the lees behind. The fairest character in our fallen condition, even amongst those who are renewed in the spirit of their minds, retains its alloy of lees, and requires to be dealt with that it may be refined, and have the pure separated from the vile.

Scripture is rich in figures, which represent this fact in all the forms that may arouse and fix attention. At one time the gracious Lord, whose purpose it is to render his people meet for a dwelling in his own presence, describes himself as a refiner and purifier of silver; adding more heat to the furnace till the object is obtained, while he 'sits' to observe the process, and at last sees his own image reflected in the precious metal. At another, he is represented as a vine-dresser, who when he sees a branch bringing forth fruit, immediately 'purgeth it, that it may bring forth more fruit.' In one place, His gospel is compared to leaven, which introduces its transforming influence into a measure of meal, and continues till it has operated on the whole mass, and subjected it to a salutary change. In another, Ephraim, when rebuked for his ingratitude and forgetfulness of God, is compared to 'a cake not turned,'—he has had no changes, and therefore has forgot his God; and the consequence is, that strangers have 'devoured

his strength, and he knoweth it not; yea, grey hairs are here and there upon him, yet he knoweth it not.'

My Christian reader will readily confess that his experience has been as that of Ephraim. Has he remained long at ease? Has the world prospered with him? Has his family arisen around him to honour and to cheer him? It was not *then* that he walked most closely with God; it was not then that the word was as a light to his feet, and a lamp without which he dared not move; it was not then that prayer was his hourly breath. It was then, on the contrary, that false friends or divers worldly pursuits had power to draw him aside, to devour the strength of his faith, the energy of his hope, and the stedfastness of his love; yet he did not perceive it. Nay, he was growing old, and approaching to his account, the silver of years was mingling with his once graceful locks, yet he knew it not. He has been at ease, and suffered loss, and a change in his lot has become necessary to renew the impression of his dependance, his feebleness, his tendency to fall away. That cloak which hung loosely around the traveller, or was ready to drop off unobserved while the sun shone upon him, is resorted to with eagerness when the storm begins to beat; and the more rudely the tempest blows, the more closely does he enwrap himself in it. Thus it is with the Divine protection and support. Let the backslider be touched with the rod of adversity, and suddenly his repentings are kindled together. Turn but one of his earthly delights into a grief, and he returns quickly to seek, if haply he may revive in his breast, the great privilege of communion with his God, which erewhile had been slighted and treated as a common thing. Open to him the prospect of the grand, the final change to which as a mortal he is exposed, and suddenly his supineness is at a close, and all is hurry to re-examine his evidence, and to recover what, in his days of uniformity and ease, he had lost.

Prosperity may leave us at liberty to rejoice while we mark the hand of Providence, but adversity adds to the lesson that of teaching us to bow under it. The hour of gladness may

be the hour of thankfulness, but the hour of calamity is that of faith in the promises. It is to the covenant-keeping God that the afflicted spirit turns, and at his footstool is it taught to plead all that he has done in time past, and all that he has engaged to do in time to come. It is the hour of painful vicissitude that brings our sins to mind, and with them the realizing conviction that 'God requireth that which is past.' The brethren of Joseph seem not to have laid their heartless barbarity to the amiable youth to heart, till the great man in the court of King Pharaoh spake roughly to them. Then, when they felt themselves to be despised strangers and foreigners, pleading for bread in an unfamiliar tongue, they remembered their heart-burnings against the guileless boy, and the dry pit in the field, and the perfidious barter by which they at once gratified their malice and their avarice, and the grief of the venerable parent, and their hypocritical sympathy. All this in the hour of their calamity flashed on their mind, and without any other association to lead to the subject, they turned to each other, and said, 'We are verily guilty concerning our brother, in that we saw the anguish of his soul when he besought us, and we would not hear; therefore is this distress come upon us.' Such is the salutary influence of vicissitude; and so wonderfully does our Heavenly Father over-rule even disappointment and unwelcome change, for the moral improvement of his rational offspring.

M. G. L. D.

SECOND WEEK—MONDAY.

RIVERS.

The cursory remarks which we have already made on springs and rivers, are far from exhausting the subject, and there are various other circumstances connected with the beneficent arrangement, which this paper is intended to describe.

Rivers, as has already been stated, owe their origin to mountains, and other elevations of the earth's surface. Were the land a dead level, we could have no running water, for a stream only moves because of the elevation of its source above its channel. At first, perhaps, a tiny streamlet, caused by the overflowing of the waters of a spring from its rocky basin, the youthful river is gradually enlarged by mountain brooks, almost equal to itself, pouring into it on either side, and by casual yet large supplies, from rain, mist, and melted snow. Near its source it is easily fordable, or is crossed by some rough tree or plank; but widening and deepening as it goes, it is at length only to be traversed by the ferry-boat, or by a series of lofty arches, connected into one magnificent bridge. It waters and fertilizes innumerable fields; mighty forests owe to it their stateliness and beauty; it furnishes drink to unnumbered flocks and herds, and to the inhabitants of populous cities; and after discharging a thousand salutary offices, whether in supplying man with its wholesome waters, or in draining an entire region of its impurities, it at last mingles its flood with the ocean.

Lakes and inland seas are commonly either formed and fed by a number of rivers, or they are but the expansion of a single stream. On a river flowing into a valley, surrounded on all sides by elevated ground, it is evident that its waters, unless they escape by some subterraneous channel, must collect, spread over a considerable surface, and rise to the level of the lowest outlet, through which they will then pass on in their way to the sea. The higher the waters have to rise before finding egress, the broader and deeper usually will be the lake that is thereby formed. Many feeders from the surrounding eminences also fall into the expanded sheet of water. Thus the lakes of Constance and Geneva may be viewed as respectively formed by the Rhine and the Rhone, and enlarged by smaller auxiliary streams. The Dead Sea, whose nauseous waters cover the site of the doomed cities of the plain, is an expansion of the Jordan. But in this instance the ground was miraculously burnt up, so that the river which formerly

beautified the whole plain in its uninterrupted progress, now empties itself into a vast cavity, and forms a lake from which there is no egress to the sea, and which, indeed, has been ascertained to be nearly a hundred feet below the level both of the Red Sea and the Mediterranean.

It has been observed, that more rivers run east or west than either north or south; and this has been accounted for by geologists from the fact, which many concurrent phenomena seem to establish, that the valleys of mountain ranges have been scooped out by a mighty current of waters, whose direction has been, speaking generally, from west to east. Thus the Po and the Danube run eastward, and the Tagus westward, according to the direction of the plains and basins which separate the mountains that produce them. Even though an extensive mountain chain runs north and south, the rivers that rise in it may yet flow east or west; for the lower ranges of hills may, and generally do, run in that direction. The Amazon, the Orinoco, and the La Plata, in South America; the St. Lawrence, the Ohio, and the Missouri, in North America, and, indeed, most of the rivers of these vast continents flow towards the east or the west, though the Andes in the former, and the Alleghany and the Rocky Mountains in the latter, run northward and southward.

The exact number of rivers in the globe can scarcely be ascertained; but it has been computed that in the united continents of Europe, Asia, and Africa, about 450, and in North and South America about 200, principal streams, discharge themselves directly into the ocean. Of brooks and tributaries there is a countless multitude. Every province of the earth is intersected with them, as with innumerable meandering streams, all subservient to the circulation of that indispensable fluid, water. When we consider the vast size of many rivers, in connexion with the number of the whole, the quantity of water they must convey to the sea appears truly incalculable. It has been computed that the Po, which, near its mouth, is 1000 feet broad, and ten feet deep, and has a velocity of four miles an hour, discharges five billions of cubit

feet of water per day, or nearly two trillions, that is, about fourteen cubic miles annually. How enormous, then, must be the annual tribute of the Amazon, before which the Po dwindles into a tiny streamlet. This majestic river, or inland flood, is 3600 miles in length, and at its mouth forms an estuary 150 miles broad. Its depth in many places is said to exceed 100 fathoms. We may form some idea of the quantity of water annually discharged into the ocean by rivers, when we learn that it amounts, on the most moderate calculation, to 1400 times the quantity discharged by the Po. Were it not for this immense and never-ending drain, the whole earth would soon be under water; for the evaporation from land and sea is so great, that though only a third of it fall upon the land, in the shape of rain or snow, and about two-fifths of that third be dissipated again through the atmosphere, or absorbed in the processes of vegetation, there will yet remain a superfluous quantity sufficient to deluge entire continents.

Rivers may, at first sight, appear to obstruct inland communication; but, in reality, they greatly facilitate it. Through their means, ships can visit the interior of mighty regions, and merchandize can be conveyed from one place to another in boats and rafts. When they are not suitable for navigation, on account of their shallowness, or of some peculiar obstructions, they can yet supply with water navigable canals. They also furnish man with a power almost unlimited, in turning the wheels that set in motion his vast piles of machinery. So useful, in many ways, are rivers, that almost all towns are situated upon their banks. It would appear, indeed, that no town can flourish unless it lie upon the sea-shore, or upon the banks of some considerable stream; while to rivers many towns owe their pre-eminent greatness. London, that most wealthy and wonderful of cities, is indebted for most of its mercantile grandeur to the Thames. Though seventy miles from the sea, it is visited by thousands of ships from every region of the globe, and into its ample docks and warehouses are incessantly poured the treasures of the east and the west. Its noble river is the king of floods, if commerce can give the pre-eminence.

Rivers, with mountains, form the best boundaries and bulwarks of kingdoms. In the time of war, they retard the progress of an invading foe, while they furnish the inhabitants of an invaded country with a most effective means of defence. The fishes, with which rivers abound, afford us a wholesome and delicate species of food. The motion of their currents also adds to the salubrity of the climate, by agitating and purifying the air.

The surpassing beauty of rivers gives a last charm to their utility. They are not only beautiful in themselves, but they are the causes of beauty wherever they flow. What object in Nature is more grandly interesting than a river among its native steeps, flinging itself sheer down some precipitous cliff? Or what more graceful and pleasing than the same river, escaped at last from the mountainous tracts, and augmented with numberless tributary streams, winding in dallying meanders along the fertile valley, clothing in living green the meadows and stately woods upon its borders, now dashing through lofty arches of stone, and now washing the walls of ancient cities and towers, bearing in its lucid bosom gay pinnaces and barges, and strange ships from foreign lands, while it approaches, with still increasing majesty and beauty, the ocean, its final and glorious destination? Thus the scenery of the river shore is of the most picturesque and delightful description. The sweet spots of the earth are watered and beautified by brooks and rivers; and no where is the grandeur of nature more visible and pleasing, than in the cataracts and rapids, and resounding currents of those mighty floods that issue forth from the mountains, to spread beauty and abundance over the rejoicing plain.

Rivers, therefore, destructive as they sometimes are in their rapid inundations, form an indispensable part of those grand arrangements by which the Creator renders the earth the fit and lovely abode of animal and vegetable life. So useful are they, that a country is rich in proportion to the number and extent of them within its limits. Thus, in every portion or general feature of nature, we find inexhaustible proofs of

matchless wisdom, of overflowing goodness. Streams and rivers murmur forth the glory of God; and, ever since the creation, they have been the ministers of his bounty. When the great Architect of Heaven and Earth himself formed an abode suited to the innocence and dignity of the noblest of his creatures, and gave it unto our first parent, as the scene of his happiness and sinless labours, he sent forth a river to water it, and make it fruitful, and to complete the beauty of its scenery. J. D.

SECOND WEEK—TUESDAY.

VEGETABLE SOIL.

In treating of the various operations of nature in this, as well as the other seasons of the year, I shall follow the plan adopted in the volume on Winter, by examining the diversified conditions of organized life in their natural order; beginning with the productions of the soil, and rising through the various genera of animals, till we arrive at man, the last called into existence, and the chief of the Creator's sublunary works. In the present paper, our attention shall be directed to the character and qualities of the soil itself.

In the previous volume it was mentioned, that in its primitive state, the crust of our earth seems to have been barren, waste, and void, consisting entirely of rocks and water, without soil, without vegetation, and without animal life; and that the first scanty soil was gradually formed by the breaking down and abrading of the rocks, which prepared nature for the sustenance of organized beings. Such is the geological theory; but whether it be admitted or not, there is no doubt that our present productive soil consists chiefly of minute particles of stone, mingled with calcareous substances, which are the spoils of marine animals, and with fat earth, being the remains of all kinds of organized bodies in a state of decomposition.

With this kind of soil, we find the surface of the earth generally covered to a greater or less depth. There are, indeed, exceptions to this, which give rise to rocky and barren wastes; but these exceptions serve to confirm the general rule, and are not so numerous as to throw the slightest doubt on the intention of the arrangement, so wise and so beneficent, by which most extensive provision has been made for a vegetation suitable to the support of living creatures over the surface of the earth.

It might have been otherwise. There seems to be nothing in the ordinary laws of nature which rendered such an arrangement necessary, or even probable. It is true, that a disintegration of rocks is occasioned by the action of the atmosphere; and that water, whether in the form of rain, of mountain torrents, or of constantly flowing rivers, is continually and actively employed in spreading the soil thus formed, over the low grounds, or carrying it into lakes or seas, on which it makes encroachments, by the formation of new deposits. But such causes, however powerful they may be, could only be partial in their operation. They tend to fill up valleys, and extend the boundaries of the dry land; but the extent of their operation must, even in a long series of ages, be comparatively very limited. Such agents give rise merely to what has been called alluvial soil, such as is found along the low banks, and at the mouth of rivers; and, if these were the only places where soil was deposited, it is easy to conceive what a naked and sterile waste the general surface of the earth would be. By far the greatest proportion of the soil is to be found in situations, and under circumstances, where the action of water, in any of the ways we have enumerated, instead of accumulating it, must have a tendency to wash it away. Such is the earth which covers all the elevated grounds, from the mountain ranges down to the gentle declivities which form by far the greater part of the cultivated lands. This is called *diluvium* by geologists, because, as stated in the preceding volume, it is justly believed to have been deposited by the turbid and agitated waters which passed over the surface of

the globe, either immediately before the era of the Mosaic creation, or during the subsequent deluge in the time of Noah, or rather at both these periods.

But whatever were the agents employed, the effect is altogether providential; and the more we consider the general aspect of the earth, in other particulars, the more reason will we have to believe that the fertile covering with which it is enveloped, is the arrangement of an Intelligent and Contriving Mind. Malte Brun, in his System of Geography, says, that "the structure of the globe presents, in all its parts, the features of a grand ruin;" and, for the truth of this, he appeals to the confusion and overthrow of most of its strata; the irregular succession of those which seem to remain in their original situations; the wonderful variety which the direction of the veins, and the forms of the caverns display; the immense heaps of confused and broken substances, and the transportation of enormous blocks to a great distance from the mountains of which they appear to have formed a part. All this is undeniable and striking, and obviously indicates some mighty catastrophe, or succession of catastrophes, by which the ancient strata of the earth have been broken up, overturned, and dislocated. But the more we become aware of the disorder in which the materials of the earth are placed, the more will we be struck with the proofs which meet us on every hand, of a regulating and over-ruling Power, which has controlled that seeming disorder, and rendered it subservient to His own beneficent purposes. I have already had occasion to advert to this view, in other instances; but let us at present apply it to the subject before us. Had the disruption and ruin alluded to by Malte Brun, and familiar to all geologists, taken place by the mere agency of mechanical causes—by some accidental explosion, for example, of a central fire, or by some oversetting of the equilibrium of the earth, or by the casual collision of a comet, without the intervention of Divine Wisdom, can it be supposed that this vast ruin would have been every where so wonderfully overspread with a soil fitted for the nourishment of vegetable and animal

life? On the doctrine of chances, is this within the bounds of probability? It is not denied, indeed, that there are ranges of rocky mountains, and a considerable extent of barren deserts; but, even allowing that such interruption to the general fertility were really a defect in the system, which, as regards the former, has been shown to be far from the truth, does not the actual arrangement, after making every possible deduction, appear clearly to be such as to preclude all idea of its being fortuitous? No candid man, who adverts to the nature of the substances of which the crust of the earth is composed, can resist the conclusion, that the clothing of its surface with vegetable mould is as much a display of skill and intention, as the enclosing of the human body in an elastic and sensitive skin, or the covering of the winged tribes with the beautiful apparatus of light and downy feathers.

In adverting to the properties of the soil, there are several things very worthy of remark, with regard to which a slight and cursory observation may at present suffice. To insure its fertility, it is necessary, on the one hand, that it should be sufficiently open and pulverized, to imbibe the moisture which falls from the heavens; and, on the other, sufficiently tenacious to retain it in a certain proportion, while it rejects what is superfluous. That this requires some nicety of adjustment, every agriculturist is well aware, as well as that, taken on an average, this adjustment has actually been established. Had the soil been, in any great degree, either more retentive or more porous, it would not have been fit for the nourishment of plants. Again, there are certain qualities characterized as vegetative, which are essential to a productive soil. To particularize these would lead us too much into detail; and it seems sufficient to remark, that such qualities are very generally diffused. We do sometimes, indeed, as I have already stated, meet with unproductive tracts, and these wastes may occasionally be the effect of barren sand, or impervious clay: but, compared with the extent of the earth's surface, these are as nothing; and, when the various ingredients of mould suitable for vegetation, are considered, it cannot but be re-

garded as a proof of providential care, that they should exist in such profusion, and be so widely spread over every region of the globe.

I need scarcely add, that there is further required an adjustment between the soil and the weather, to insure the development of its fertile qualities, and that this adjustment also has been established. Whatever be the climate, from the extreme heat of the tropics, till, towards the poles, the cold becomes too intense for the comfortable existence of animal life, the earth is covered with the mould adapted for the nourishment of such vegetables as that climate is capable of bringing to maturity.

These considerations sufficiently indicate the superintendence of an Almighty Designer, and loudly call for the devout admiration and gratitude of that rational race on whom he has bestowed the high faculty of tracing his hand in his works, and the glorious privilege of giving utterance to the sentiments which his perfections inspire.

SECOND WEEK—WEDNESDAY.

VEGETATION.

Of all the wonders with which we are surrounded, in this mysterious world, there is none more worthy of admiration than the principle of life in organized existences. Its essence is far beyond the human ken, but some of its properties we perceive and can investigate.

The chief intention of the Creator in all the arrangements on the surface of our globe, is, doubtless, the support and enjoyment of sentient beings; and, above all, the education of intelligent creatures for a higher mode of existence. But it would appear that the crude materials of which the unorganized crust of the earth is composed, were not found, in the great plan of the Creator, to be suitable for the first of these purposes, the sustenance of animal life; and therefore an in-

termediate mode of existence was to be employed, by which the proper nourishment of living creatures was, by a most curious and skilful process, to be extracted from the soil, and to be scattered profusely over the face of the earth, in various forms, containing all the qualities of beauty and utility. Such is the vegetable world; a system which, while it admirably fulfils its primary destination, is at the same time adapted, with consummate wisdom, to perform other functions of great importance in the economy of the animated creation.

The first property necessary for the continued existence of vegetation, is the power of absorbing from the surrounding elements the materials which constitute its nourishment. For this purpose, each individual plant, with few exceptions, is connected with the soil by a root, and shoots up into the air by a stalk, and expands itself generally by means of branches and leaves, thus drawing its nutriment both from the soil and the atmosphere, and opening its bosom to the genial influences of light and heat. Again, provision is made for the secretion and assimilation of the various substances received into the system of plants, for the circulation of the nutritive juices, for the deposition of the solid materials in their proper situations; and, in short, for the development and maintenance of the whole organization. That organization itself is full of wonders. The elementary texture of a vegetable is formed of vesicles, the coats of which consist of transparent membranes of extreme tenuity, and of such minuteness, that, according to Kieser, the diameter of each individual cell varies, on a moderate estimate, from the 55th to the 330th part of an inch; so that, from 3000 to 100,000 cells would be contained in an extent of surface equal to a square inch. Kirby goes far beyond this statement, and assures us that these vesicles are occasionally so inconceivably minute, as not to exceed in diameter the thousandth part of an inch; in which case, no fewer than 300,000 of them might be contained in a square inch. These adhere closely together, and form by their union a species of cellular texture, which may be considered as the basis of every organ in the plant.

Fluids of different kinds are diffused over the plant, occupying both the cells and the intercellular spaces, which consist either of a watery sap, or of peculiar vegetable secretions. Among these vesicles are found, in most species of plants, numerous ducts, interspersed throughout every part of the system, containing air, and hence called *air-tubes*. There are also found in the interior of vegetables, certain organs named *glands*, which perform the important function above mentioned, of secretion, that is, the conversion of the juices, by a kind of alchymy, into the products necessary for the nourishment of the plants. Besides these internal parts, an external covering is provided, to protect the plant from the injurious effects of the atmosphere, and of the moisture it deposits. This is termed the cuticle, which is spread over the whole surface, investing the leaves and flowers, as well as the stem and branches; and this membrane is perforated in various parts, but especially in the leaves, with minute oval orifices or *stomata*, which have the power of opening and shutting, and are intended to exhale water, and perhaps sometimes also to absorb air.

The form and organization of the root is not less worthy of notice. Considered as the means of attaching the plant to the ground, the contrivance is most admirably suited to its function, this provision being proportioned to the degree of power required; so that, although in low shrubs and plants which are not destined to experience much external violence from storms, little precaution is exerted; yet in the case of lofty trees, and especially in such as are furnished with dense foliage and wide-spreading branches, which present a large surface and powerful lever to the wind, the most studied and skilful contrivances are adapted to enable them to take firm hold of the ground, and to resist the tremendous force with which, in tempestuous weather, they are assailed. Nor must another and still more essential function of the root be forgotten, I mean that of drawing the nutritive juices from the soil. This is effected by means of what are termed *spongioles*, situated at the extremity of the rooty fibres. These, acting

as sponges, from their resemblance to which they derive their name, imbibe the various vegetative qualities inherent in the earth, which, partly by means, as is generally believed, of capillary attraction, and partly by some mysterious vital power, are conveyed upward through the curiously organized vessels to form the food of the plant.

This rapid view of the general conformation of a plant, may suffice to show with what wonderful care the organization of the vegetable world is adapted to the condition of external nature, and how irresistibly the student of nature in this department is led to acknowledge the existence of Creative power and wisdom. It is reported of Galileo, the most profound philosopher of his age, that when interrogated by the Inquisition as to his belief in a Supreme Being, he pointed to a straw on the floor of his dungeon, and replied, that even if he had no other proof of an Intelligent Creator, the mechanism of that fragment of a plant would be sufficient;—and not without reason, for even in the form of a stalk of corn, there are indications of contrivance, the force of which no candid mind can resist.

Another essential property which belongs to vegetable life, is the power it possesses of propagating the species. One of the most marked conditions of organized existences is that of perpetual change. The plant rises and flourishes, and then, in a few years, frequently indeed in a few months, decays and dies. Had there not been some means employed, therefore, of preserving the species after the individuals had mingled with their parent earth, the world would have quickly been reduced to a barren and lifeless waste. But there is nothing more remarkable in the constitution both of the vegetable and animal worlds, than the careful provision which has been made for preventing this catastrophe, not only as respects organic life in general, but as respects each distinct kind of organized existence, which the plastic hand of the Creator has formed. All are endowed with an ample, and even redundant, capacity of giving rise to offspring of their own species. The manner in which this is almost uniformly effected in the

vegetable world, as I formerly stated, is by means of seeds, which they propagate in various forms, preserve by various contrivances, and scatter over the soil in various ways, and which are by their peculiar conformation and properties, as will afterwards be seen, most curiously and skilfully adapted to the functions they are destined to perform.

The properties we have mentioned are common to all, or at least to by far the greater part of terrestrial plants; and the remarkable uniformity which exists in their general structure, is a clear indication of One Contriving Mind. But the law of diversity is not less remarkable in their formation, than the law of coincidence and analogy. There are certain definite objects to be accomplished by each species, and in them all there is a striking conformity of type; and yet amidst this uniformity both of intention and of original model, there exists a variety at once interesting and surprising. This is the case not merely in the vegetable but animal world, in a degree which is exceedingly remarkable, even on the slightest inspection, and which grows upon us as it is contemplated. 'In every department of nature,' says Mr. Kirby, from whose work the facts contained in this paper are drawn, 'it cannot fail to strike us, that boundless variety is a characteristic and predominant feature of her productions. It is only when the object to be attained is dependant on certain definite conditions, excluding the possibility of modification, that these conditions are uniformly and strictly adhered to. But wherever that absolute necessity does not exist, and there is afforded scope for deviation, there we are certain to find introduced all those modifications which the occasion admits of. Not only is this tendency to variety exemplified in the general appearance and form of the body, but it also prevails in each individual organ, however minute and insignificant that organ may seem. Even when the purpose to be answered is identical, the means which are employed are infinitely diversified in different instances, as if a design had existed of displaying to the astonished eyes of mortals, the unbounded resources of Creative power. While the elements of structure are the

same, there is presented to us in succession every possible combinatiom of organs, as if it had been the object to exhaust all the admissible permutations in the order of their union.'

SECOND WEEK—THURSDAY.

PRESERVATION AND DISTRIBUTION OF SEEDS.

I HAVE already stated, that the chief method by which the Author of Nature has provided for the reproduction of plants, is by means of seeds. This method may be considered as universal, for there is no perfect plant which is not produced by means of a seed; although other methods, also, are sometimes employed, such as propagation by means of runners or off-sets, or by the rooting of branches. Seeds, as I have noticed, resemble in some remarkable particulars, the eggs of fowls and insects; and, in the same analogy, the spawn of fish may also be included,—thus exhibiting one of those features, by which the various orders of organized beings appear to be so mysteriously related, and in which we trace so unequivocally the handiwork of a common Creator.

There are many tribes of vegetables, which from year to year, depend entirely for their reproduction on seeds. The plant having given birth to this embryo of its species, and deposited it in the soil, withers down to the root and expires. Now let us look at this curious production. It is composed of various parts, named cotyledons, corcle, membranes, and vessels. The cotyledons are composed of a cellular network, curiously organized, which forms the substance of the seed, and contains the albuminous matter, which nourishes the young plant in the earlier stages of its existence. The corcle is the embryo of the future plant, and lies between the cotyledons; it differs in its structure at different stages, consisting at first of a thin glary fluid, and afterwards becoming more concrete and regularly organized, till at last it displays the rudiments of the root and of the plumale, or future stalk. We have

named the seeds of plants, vegetable eggs; and every one must observe in this description, a remarkable similarity between the eggs of animals, and these productions of an inferior kingdom; and this remarkable resemblance to the animal embryo, is still further exhibited in the existence of an umbilical cord, which attaches to the seed till it be perfectly ripe, and through which it receives its nourishment from the parent plant.

These seeds, when it is intended that they shall lie dormant, in a temperate climate through the winter, to reproduce the species in spring, are furnished with every property necessary for the intended purpose. They remain in the bosom of the ground, sometimes protected by peculiar contrivances to preserve them from the severity of the season; but, whether this be the case or not, they are always endowed with qualities, or subject to conditions, which are sufficient for the preservation of the species, being, generally speaking, uninjured by the cold and wet, and unaffected by the alternations of comparative heat and cold, till the genial season of spring returns, when they can extend their roots, shoot forth their plumales, raise their foot-stalks, and unfold their tender leaves with impunity.

We have already observed, that this mode of propagating the species is universal: It belongs to all the various orders of plants, whether herb, shrub, or tree, and whether annual, biennial, or perennial. Some of these species preserve their seed in the pod, through the winter months, and others both produce and scatter their seed in the early part of the vegetating season, so as to give rise to the seedling, or the full grown plant, before the cold weather, which ends the year, has set in. These varieties, in the manner in which the seed is employed, occasion the necessity of varieties, also, in the mode of propagation, which are abundantly curious and admirable. Some seeds are enclosed in shells, others in purses; some are lodged in capsules, some in wooden sheaths; and others again, are placed deep in the heart of fruit, which serves at once for their protection and nutriment, and, in some instances per-

haps, also for a rich and appropriate manure, as it decays on the surface of the earth.

In speaking of fruit as the means by which the seed is frequently shielded, I do not forget that this very fruit forms the food of various animals; and this gives rise to another proof of Creative contrivance; for while the food itself is digested, and affords nourishment to the animal, the seed in many instances is voided uninjured, and perhaps better prepared for vegetation; and it is thus that the Creator has provided for the dissemination of various plants, and even for their transportation to islands, and other localities, which they could not otherwise reach.

This leads me to state, that if some provision were not made for the dissemination of plants, they would seldom be far removed from the locality of the parent. Contrivances, therefore, for this purpose, were requisite, and they are many and singular. Numerous seeds, for example, are furnished with an elastic pod, which, on bursting, projects its contents to a considerable distance. Of this we have a well-known example in the common furze. Nearly all the seeds of compound flowers are provided with a species of wings, through which means they are conveyed, by the wind, to distant places. The thistle and dandelion are of this kind. Other seeds, as the bur, are scattered abroad, by laying hold, by means of hooks, on passing animals; and not only do birds and some quadrupeds perform, as we have stated, an important part in this useful office, by swallowing the seeds contained in berries and fruits, but some animals, both of the insect and larger orders, contribute to the same end by their storing instincts. Nor must we forget the effects of streams and rivers in the accomplishment of this useful intention. So various and so wise are the means by which the Creator accomplishes this beneficent purpose.

To all this I must add the power with which the Author of Nature has endowed various seeds, of retaining the vital principle for a lengthened period. Ray mentions, that, after the great fire in London in 1666, a plant (*Sysimbrium iris*),

the seeds of which must have lain dormant for several hundred years, covered, to an amazing extent, the walls of the buildings which had been burned.* The seeds which are sometimes discovered enclosed within the cerements of Egyptian mummies, and which have been found to germinate when lodged in the soil, is another remarkable example. Gerardin mentions other instances of the same kind; and, in particular, one which happened under his own eye, in the 'Jardin des Plantes,' all which shows in seeds a wonderful tenacity of life, doubtless implanted for a wise and obvious purpose. This, indeed, is only another instance of what we have already noticed, that, in the operations of the Author of Nature, there appears to be no intention more apparent, or more sedulously pursued, than that of the preservation and

*The following observations on this curious subject, are extracted from a notice in Professor Jameson's Philosophical Journal, for the quarter ending January, 1826. '*Spontaneous Plants.*—Few things are more extraordinary than the unusual appearance and development of certain plants, in certain circumstances. Thus, after the great fire in London, in 1666, the entire surface of the destroyed city was covered with such a vast profusion of a species of cruciferous plant, the *Sisymbrium iris* of Linnæus, that it was calculated that the whole of the rest of Europe did not contain so many plants of it. It is also known that, if a spring of salt water makes its appearance in a spot, even a great distance from the sea, the neighbourhood is soon covered with plants peculiar to a maritime locality, which plants, previous to this occurrence, were entire strangers to the country. Again, when a lake happens to dry up, the surface is immediately usurped by a vegetation, which is entirely peculiar, and quite different from that which flourished on its former banks. When certain marches of Zealand were drained, the *Carex cyperoides* was observed in abundance; and it is known, that this is not at all a Danish plant, but peculiar to the north of Germany. In a work upon the Useful Mosses, by M. de Brebisson, which has been announced for some time, this botanist states, that a pond in the neighbourhood of Falain having been rendered dry, during many weeks in the height of summer, the mud, on drying, was immediately and entirely covered, to the extent of many square yards, by a minute compact green turf, formed of an imperceptible moss (the *Phascum axillare*), the stalks of which were so close to each other, that, upon a square inch of this new soil, might be counted more than 5000 individuals of this minute plant, which had never previously been observed in the country.'—P. 209, Article *Scientific Intelligence.*

propagation of the various species of organized existences which his Creative Power has formed. So true is this, that, throughout every department, an inquirer cannot fail to be deeply impressed, at once with the diversity, the admirable adaptation to circumstances, and the efficiency of the contrivances by which the object is effected.

SECOND WEEK—FRIDAY.

LONG VITALITY OF SEEDS.

After writing the preceding paper, I met with some curious observations, by Mr. Jesse, on the long vitality of seeds, which are so appropriate, that I adopt them as the subject of this day's consideration. They will be found to be in perfect harmony with the facts alluded to yesterday, and may perhaps tend to explain some of the curious circumstances mentioned in the note extracted from Professor Jameson's Journal.

'Few things appear to me more curious than the fact, that the seeds of various plants and flowers, which have lain dormant in the ground through a succession of ages, have either, by being exposed to the air, been enabled to vegetate, or have been brought into action by the application of some compost or manure agreeable to their nature.

'This was shown in trenching for a plantation at Bushy Park, which had probably been undisturbed by the spade or plough since, and perhaps long before, the reign of Charles I. The ground was turned up in winter, and in the following summer it was covered with a profusion of the tree-mignionette, pansies, and wild raspberry,—plants which are nowhere found in a wild state in the neighbourhood;—and, in a plantation recently made in Richmond Park, a great quantity of the fox-glove came up, after some deep trenching. I observed, a few years ago, the same occurrence in a plantation in Devonshire, the surface of which was covered with the dark-blue

columbine,—a flower produced in our gardens by cultivation, and I believe not known in this country in its wild state.* A field, also, which had little or no Dutch clover upon it, was covered with it, after it had been much trampled upon, and fed down by horses; and it is stated, from good authority, that, if a pine forest in America were to be cut down, and the ground cultivated, and afterwards allowed to return to a state of nature, it would produce plants quite different from those by which it had been previously occupied.

'So completely, indeed, is the ground impregnated with seeds, that, if earth is brought to the surface, from the lowest depth at which it is found, some vegetable matter will spring from it. I always considered this fact as one of the surprising instances of the power and bounty of Almighty God, who has thus literally filled the earth with his goodness, by storing up a deposit of useful seeds in its depths, where they must have lain for a succession of ages, only requiring the energies of man to bring them into action. In boring for water lately at a spot near Kingston-on-Thames, some earth was brought up from a depth of 360 feet. This earth was carefully covered over with a hand-glass, to prevent the possibility of other seeds being deposited upon it; yet, in a short time, plants vegetated from it. If quicklime be put upon land, which, from time immemorial, has produced nothing but heather, the heather will be killed, and white clover will spring up in its place.

'A curious fact was communicated to me, respecting some land which surrounds an old castle, formerly belonging to the Regent Moray, near Moffat. On removing the peat, which is about six or eight inches in thickness, a stratum of soil appears, which is supposed to have been a cultivated garden in the time of the Regent, and from which a variety of flowers and plants spring, some of them little known, even at this time, in Scotland.

'The care which is taken to supply the ground with those

* I have since learned that the Columbine is found wild in the western counties.

seeds, which, from probably being of a farinaceous nature, would not preserve their vital powers through a succession of ages, as other seeds do, is very curious. Many of them are deposited by crows, and other birds and animals. The Rev. Mr. Robinson, in his "Natural History of Westmoreland and Cumberland," says that "birds are natural planters of all sorts of trees, disseminating the kernels upon the earth, where they grow up to their natural strength and perfection." He tells us, that early one morning he observed a great number of crows, very busy at their work upon a declining ground, of a mossy surface; and that he went out of his way on purpose to view their labour. He then found that they were planting a grove of oaks.* The manner of their planting was thus:—They first made little holes in the earth with their bills, going about and about till the hole was deep enough, and then they dropped in the acorn, and covered it with earth and moss. "The young plantation," Mr. Robinson adds, "is now growing up to a thick grove of oaks, fit for use, and of height sufficient for the crows to build their nests in. On telling the circumstance to the owner of the ground, who observed the acorns to spring up, he took care to secure their growth and rising. The season was the latter end of autumn, when all seeds are fully ripe."

'Mr. Edwards observes, that even the droughts of the autumn continue to increase and propagate seeds and plants; for, by causing deep chinks or chaps in the earth, the seeds of trees, and larger plants, that require depth, are lodged at proper depths for their growth, and, at the same time, secured from such animals as feed upon them.

'Mice also bury a great number of seeds for their winter stores, many of which vegetate:

Sæpe exiguus mus
Sub terris posuitque domos, atque horrea fecit,—

and some seeds are provided with a sort of down, by which

* I have observed in another place, that rooks probably bury seeds, for the purpose of feeding upon them in winter.—H. D.

they are carried, with the help of the wind, to great distances; and others fix themselves on the ground by means of a glutinous substance attached to them.

'It is a curious fact, in proof of what has been advanced, that more recent deposits of earth, such as peat, leaf-mould, &c., produce little or no vegetable substances, while, as has been shown, soil, from whatever depth it is brought, is impregnated with seeds, which grow freely on being exposed to the influence of light and air.'

May not some of the curious and interesting facts above quoted, from an acute observer of nature, corresponding as they do with similar instances, well known to the naturalist, be referred to the period of the universal deluge, and account, without difficulty, for the rapid springing up of all kinds of vegetable existences, in their proper localities, after that great catastrophe? If the soil deposited by the waters of the flood was, to so remarkable an extent, mixed with seeds, as the impregnation of the earth brought up from the depth of 360 feet, and other facts, seem to imply, we shall find little difficulty in accounting for the general diffusion of plants over the face of the earth, each species in the situation suited for its growth, and we shall cease to be astonished that the plants of temperate, and even of Arctic climates, should be found in the higher elevations of the Himmalayah Mountains, the Andes, and other tropical mountain ranges. Among the varieties of seeds thus dispersed and deposited, those exposed on the surface, or within the range of the action of the atmosphere, which were unfit for the soil and climate, would perish, while a single seed, adapted to these conditions, would soon spread over extensive regions.

SECOND WEEK—SATURDAY.

DEVELOPMENT OF SEEDS AND PLANTS.

Many very ingenious experiments have been made by the most eminent chemists to investigate the laws of vegetation,

and to analyze the substances employed or produced in the vegetative process; but so much mystery is still connected with the subject as to render it probable that, beyond a certain point, human ingenuity will never be permitted to penetrate. There are, however, many curious facts, which experiment, and assiduous attention to the subject, have established; and some of the most interesting, and easily comprehended of these, I shall now endeavour to state in a popular manner, abstaining, as much as possible, from scientific details.

In the first place, it has been found that the three great agents in developing the vegetative powers of plants, are water, air, and heat. If any of these agents are absent, the seed will not germinate. If they are present, in certain proportions, the process of germination will, in every instance, proceed through its first stages, without the co-operation of any other substance or property. Now, observe how these conditions are adapted to the state of external nature. The atmosphere with which the earth is everywhere surrounded, is composed of air and watery vapour, the latter of which it gives out, at intervals, in the form of rain, and the former of which exists, in such proportions, as always to be at hand for the purposes required; and, with regard to heat, its presence, at certain periods of the year, in greater quantity than at others, gives rise to all the grateful vicissitudes of the seasons, and exhibits an adaptation full of wisdom and goodness, the nature of which has already been partly considered, and will be still further unfolded as we proceed.

Observe further, that there are two distinct parts of a plant contained, in embryo, in every seed, the one consisting of the root, and the other of the plume or plumale, or what, when developed, is in ordinary language, called the stalk of the plant; and, to the growth and perfection of these, different conditions are required, corresponding to the various functions they are destined to perform. The root is intended to execute two important designs, as has been already observed, the one to select nourishment for the plant, the other to fix it

firmly in the ground; the plume, on the other hand, has to shoot up into the open air, that it may be patent and convenient for supplying the wants of animal life, and may thus fulfil its appointed office in the wonderful economy of nature. Here, again, there is an adjustment, which clearly indicates intention, in the proportions in which the three essential elements are required. The root has to exist beneath the surface of the ground, where, indeed, air and heat, as well as water, exist, but by no means in the same relative quantities as above the surface; but that is a difference precisely suited to the constitution of this part of the vegetable, and indeed, in some respects, essential to its healthy state. And here is another, and still more remarkable adjustment in the difference which exists between the requirements of the root and plume, with reference to external nature; the former demands darkness, the latter light, for its healthy development. The root, having to seek for nourishment under ground, where the solar rays are excluded, is so formed by the All-wise Creator, as to stand in no need of light. It can exist indeed, when exposed to the day, and even, under peculir circumstances, in this situation, can expand vigorously; but it covets darkness, and is, obviously, in its most luxuriant, as well as appropriate state, when the light is excluded. It is not so, however, with the plant itself. It is true, that the vegetative process will proceed even in absolute darkness; and this property is of moment, both because the seed is frequently buried so deep that the plume must make considerable progress in its development, before it emerges to the light of heaven, and also because darkness alternates with light, in consequence of the diurnal revolution of the globe. But light is of essential importance in contributing to the vigour, and to various highly useful, as well as ornamental properties, of plants. 'When deprived of light,' says Dr. Irvine, 'all plants nearly agree in the qualities of their juices. The most pungent vegetables then grow insipid; the highest flavoured inodorous; and those of the most variegated colours, are of an uniform whiteness.' 'Vegetables which grow in a

natural situation, burn when dry; but a vegetable bud, in a dark box, contains nothing inflammable.' We have here, in few words, the effect of light on vegetation. To this agent it owes taste, smell, colour, and inflammability; the three former qualities obviously adapted to give peculiar gratification to the senses with which Providence has endowed us; the latter necessary for bestowing upon man that fuel, the use of which at once compensates to him the defective heat of an ungenial climate, and endows him with an amazing power, that enables him to increase his comforts, exalt his enjoyments, and sharpen his faculties, in the advancement of the arts of civilized life.

Another circumstance connected with these properties, is the mysterious principle existing in the seed, by which, in whatever way it is deposited in the soil, it adjusts its position so as to push its plumale upward, and find its way, by the most direct path, to the light of day, while it sends its root downward, and in lateral directions, with obvious, and, as it were, studied predilections in favour of the most fertile soil, and the securest position for the support of the plant. These properties have attracted the attention, and excited the curiosity, of scientific men; and various conjectures have been hazarded with regard to the mechanical or chemical laws by which the opposite tendencies of the different parts of the same plant are regulated. 'These tendencies,' says the author of an elaborate article on Vegetable Physiology, in the Supplement to the Encyclopedia Britannica, 'have been ascribed to the action of light on the plume, and of earth on the radicle; but the radicle equally descends, although no earth be present, and the plume rises although light be excluded. Others have attributed the descent of the radicle to the greater weight of its sap, and the ascent of the plume to the lighter condition of that fluid; but there is no evidence that, in these parts respectively, any such difference of sap exists. More lately, it has been supposed that gravitation acts in causing the descent of the radicle; and attempts have been made to counteract this force, by keeping seeds during their evolu-

tion, in continued motion, on vertical or horizontal wheels; but the results obtained seem only to prove that, in such circumstances, the radicle and plume pursue, as usual, opposite directions, without affording any evidence, why, in natural growth, the one always rises and the other descends.' All this leads to the belief, that the principle, which is attempted to be discovered, lies deeper than human reason can easily penetrate, and is probably involved in the mysterious qualities of vegetable life, which the power of the Creator has infused into organized existences of this order.

But there are various other processes not less remarkable, and scarcely less mysterious. The sap is supposed to rise in the plant, as we have said, partly by means of capillary attraction, and partly also by means of some unknown vital property, supposed to be a contractile power in the vegetable tissue. The temperature of the atmosphere is of essential importance for promoting this process; and, before the formation of the leaf, the sap seems, from various experiments, to rise and fall, or to remain stationary, according to the state of the weather, like mercury in the tube of the thermometer. But, as soon as the plant has expanded its leaves, the sap* flows regularly towards them, and the plant ceases to bleed when incisions are made. The reason is, that, through the pores of the leaves, a constant and powerful perspiration takes place, which throws off the superfluous watery particles of the sap, while the proper food of the plant, contained in the fluid, is, at the same time, retained and secreted. This perspiration by the leaves is much greater than could readily be believed, without actual experiment. Woodward found that a sprig of mint, weighing only 27 grains, imbibed, in 77 days, 2558 grains of water, yet its weight was only increased 15 grains, and it must, therefore, have given off, in that time, 2543 grains of fluid. It is during the transmission of the sap through the leaves, that what remains in the plant re-

* It appears that, about 99 parts in 100 of the sap is pure water, the rest consisting chiefly of acetate of potass, vegetable matter, and carbonate of lime, with the addition sometimes of tannin, alum, sugar, &c.

ceives its peculiar consistence, colour, odour, and taste, differing materially in each species, and hence called the 'proper juice.' 'It is in this proper juice,' says Du Hamel, 'that the narcotic power of the poppy, the corrosive quality of the fig, the diuretic virtue of the fir, and the purgative property of jalap, reside; and even the peculiar products obtained from the sugar-cane and maple, arise probably from the intermixture of the proper juice with the common sap.'

That the extraordinary changes of sap by which plants acquire their peculiar and distinctive qualities take place chiefly in the leaves, seems now to be generally admitted, as well as that the effect is, to the greatest extent, produced by the combined agency of light and air. But here experiment stops short, and philosophy is at fault. Some of the chemical combinations which are produced in the process of vegetation, have indeed been ascertained; but these discoveries have contributed little to the development of the principle on which vegetable life depends; and we must be content with the humbling, but salutary conviction, that 'such knowledge is too great for us; it is high, we cannot attain unto it.' Let it lead us to regard, with more profound veneration, that wonder-working Hand which has, with such consummate skill, combined all the powers of nature into one harmonious whole, and employed them so mysteriously, yet with such obvious wisdom and goodness, to promote the subsistence and enjoyment of the various orders of living beings.

THIRD WEEK—SUNDAY.

ANALOGY OF NATURE.

All nature is fertile in analogies. Points of resemblance, striking and innumerable, may be discovered between the laws and conditions of the animate and inanimate creation,—the world of matter and the world of intelligence. In all

things perceptible by our senses, or the objects of our intellectual powers, may be traced the evident marks of the *same* designing hand. And thus, not only does every department of moral and material nature proclaim the existence of a Deity, but it shows forth, with resistless evidence, the unity of the great Creator.

The analogies now alluded to might be divided into several classes, and named according to the arts, or the objects of human pursuit with which they are connected. First, might be mentioned, those grand, or, it may be, fine and subtle analogies, that so frequently guide the inquiries and influence the conclusions of the philosopher, and which might, therefore, be termed philosophical; then come those beautiful and delicate resemblances that charm the imagination, and minister so largely to poetry, which might properly be called poetical analogies; but a higher and nobler species than either of these would still remain to be described,—I allude to that great and exhaustless class, which we discover, when we attentively compare the volumes of Nature and Revelation, to exist between the kingdoms of Providence and Grace,—between the spiritual and the material worlds. This last would embrace all those moral and religious analogies which every devout Christian traces with such profit and delight.

Spring, above all other seasons, the pleasant theme of the moralist and the poet, is pregnant with analogies that feed the fancy, and awaken to pleasing and serious reflection. Nature now appears to be emerging fresh and beautiful from a gloomy chaos, or at least to rejoice in the gladness of renovated youth. To the poetical fancy her opening blossoms vividly image forth the warm promises of hope; the music, that fills the woods and fields, sounds like the thrilling tones of joy from hearts to which these promises have been fulfilled. The gay and blossoming earth, containing in her bosom the future riches of summer and autumn, is the chosen emblem of youth, which is soon to ripen into manhood's strength and fulness.

But a mind imbued with the distinctive doctrines of Reve-

lation, and which delights to trace the hand of the Great Author of all things in his word and works, perceives, in the operations of this interesting season, a far grander and nobler image; and, in the reviving world, discovers the liveliest material type of the resurrection. Not less wonderful or less inexplicable, is the universal bursting forth of vegetable life from seeming death, than the sudden reconstruction of the long dissolved and mouldering body. When we see, year by year, the most beautiful and stately vegetable forms springing up from minute and apparently decayed seeds and germs, some to flourish in rank luxuriance, others to bear blossoms and precious fruit, can we think it incredible that, in the revolving cycle of Providence, an eternal spring shall arrive, in which immortal forms shall spring from the dust and ashes of the tomb? The God under whose directing and sustaining hand there is an annual resurrection of Nature, has clearly promised the re-animation of our decayed and apparently forgotten bodies. In the one, he gives us a lively and constantly recurring type of the other. Between the annual revival of the earth and the general resurrection, the analogy is striking; and it finely harmonizes with the uniformity stamped on the vast economies of nature and of grace. Before man rises to eternal life, he must pass through the winter of the tomb; he must lie down in corruption before he can rise in incorruption. As the plant loses its bloom and ripened fruit, withers, and disappears from the face of the ground, to spring up in renewed loveliness at the appointed season, so the children of men grow old, and sink into the grave, to rise again, clothed with immortality, at the judgment day.

Yet the analogy is not complete. The tree renews its leaves, or the flower, which, in autumn, died down to the earth, springs again from the root; or the seed which has been scattered in the ground, shoots into life and beauty a new plant; or the insect which spent the winter in a lethargic sleep, awakes, to pass a second time through a series of surprising transformations: and all these wonders forcibly remind us of our own great change, and speak of Him who

brought life and immortality to light. But there is one important particular in which the analogy is defective. These objects revive, or are renewed, to run the very same round as that of the preceding year, to be subject to the same conditions, and to fulfil the same destiny. They but move in a cycle, without progression. It is not the passing from a lower to a higher grade of being,—it is not the exchange of one world for another. The leaf, the flower, the plant, the insect, are still the very same, or, if different individuals, at least of the very same species, existing under the same conditions as in the year before. But it shall not be so with man. At his resurrection he shall be raised a spiritual body; his very material part shall be refined and glorified; and instead of being bound to earth, and subject to earthly conditions, he is destined to ascend into a new and more exalted sphere, and, leaving the bounds of this nether world, with its vicissitude, sorrow, and death, and meeting his Lord in the air, to become an heir of immortality, a denizen of the celestial paradise, an associate of angels, a friend and companion of the Son of God, an adopted child of the Eternal himself.

The analogy, however, though incomplete, is pleasing. It is true that it cannot furnish us with an argument in favour of our future existence, which, indeed, we do not require; but it affords us an agreeable illustration of an infinitely important truth, with regard to which, on other grounds, our faith is firm and confident. Of a similar illustration an inspired apostle has not disdained to make use; and as *he* employs it, it is not only legitimate and complete, but highly instructive. 'That which thou sowest is not quickened except it die; and thou sowest not that body which shall be; but bare grain, it may chance of wheat, or some other grain; but God giveth it a body as it hath pleased him. So also is the resurrection of the dead. It is sown in corruption, it is raised in incorruption; it is sown in dishonour, it is raised in glory; it is sown in weakness, it is raised in power; it is sown a natural body, it is raised a spiritual body.'

May such be the thoughts we cherish at this charming and

critical season. Let us not merely revel in the enjoyment that every sense affords us, as we traverse the reviving fields, and inhale the odorous breeze : Let us not give way to vague feelings of gratitude and delight, and luxurious but profitless musings. Our eyes should not merely be open to the beauty, and our ears to the harmony around us, as if indulgence in animal joy were our sole duty or proper employment, when we hail the opening spring. Be ours the task rather to deduce and apply the moral lesson of the season, and to view the grand renovation going on upon the face of the earth, chiefly in connexion with the sublime christian doctrine, which it so impressively shadows forth. When the eye rests on the innumerable blades of grass, or the countless forest leaves, all unfolded to the light by the reviving breath of spring, let us think of the millions of our mortal race that shall one day, by a more visible but not more powerful exertion of the Almighty arm, arise from among the clods of the valley, to exist in another and never-ending state of being.

And if such be the tenor of our thoughts, can we forget that, after the resurrection, comes the final judgment? In the mind of the Christian these two great events will ever be associated ; and surely they cannot fail to solemnize his soul, and incite him to faithful preparation. If we live and sink into the dust like noxious weeds, having only brought forth the poisonous fruits of unrighteousness, the gloomy winter of the grave will be but a faint emblem of that everlasting darkness and despair which shall be our only portion. But if we fall laden with the precious fruits of faith, with these all-glorious shall we rise, to rejoice in one eternal summer in the paradise of God. J. D.

THIRD WEEK—MONDAY.

THE VITAL POWERS OF PLANTS.

On Saturday, as well as in some former papers,* I have anticipated several observations on the functions of vegetable life; but there are still some circumstances relative to this interesting subject, which have either not been as yet noticed at all, or have been but slightly alluded to, and which yet naturally come under review in considering the physiological condition of plants in spring. To these I shall now shortly advert.

The function of secretion is one of those hitherto inscrutable mysteries which belong to organized life in the vegetable as well as the animal world. By this power, is meant 'the separation of a peculiar matter from the general mass of fluids, by some particular structure, and which may either retain its fluid state or become solid.' The first remarkable circumstance which strikes the inquirer is, that though the mass of fluids from which the secretions are produced be one and the same, and the secreting organs, as to externals, be often in the same condition, yet the matters secreted in these various organs differ greatly from each other. Thus, an essential oil is found only in the rind of the orange, a fat oil only in the kernel of the almond; and so with regard to other secretions, which exist only in particular parts. Besides the acids, alkalis, earths, and metals, which, though of a mineral nature, are more or less constantly found in plants, chemists enumerate about forty products of vegetation, which possess distinct chemical characters; and of many of these products numerous varieties exist. As none of these substances can be detected in the common sap, they must have been elaborated by the specific organs of vegetables, under a process of secre-

* See Papers on the Hybernation of Plants—'*Winter*,' Fourth Edition, pp. 162–177; and on the Balance of the Animal and Vegetable Creation —'*Winter*,' pp. 78–85.

tion. By what peculiarity of structure or of function these organs are enabled to produce such remarkable chemical changes in the common sap is quite unknown; neither do we know how much is to be attributed to the action of the organ itself, or to the reaction of the several ingredients on each other, or to the influence of external agents. From all that appears, however, these changes are necessarily connected with the principle of life, no such effects being ever produced either by experiments on the sap itself, independent of the secreting vessels, or by any extraneous combination of ingredients.*

Of all these products of secretion, the most remarkable, and the most important to the plant, is a mucilaginous fluid named *cambium*, which is employed directly in vegetable nutrition and growth, and may be considered as analogous to chyle in animals. This substance is formed directly from the proper juices, which, again, are formed from the sap; and though these differ from each other very widely in different plants, as to their sensible and chemical properties, the cambium seems, in all plants, with regard to these, to be nearly the same. It is without colour, odour, or taste, though the proper juices exhibit all these qualities. The proper juices, also, are contained in the vessels, and flow out when they are divided; but the cambium transudes rather than flows, and that only in places where new parts are to be formed. Thus, in the pine, says Mirbel, while the proper, or resinous juice, flows in the large vessels, the cambium transudes beneath the *liber*. Of the other secretions of plants, which are found

* It is a curious fact, that some of the substances most essential to the nutriment of plants, though differing very materially in their sensible qualities, are, on chemical analysis, found to be composed of precisely the same constituent parts, united in proportions, but slightly differing from each other. Thus, Dr. Prout gives the following analysis of the relative composition of gum, starch, sugar, and lignim:

1000 parts of gum arabic, yield.....585 of water, and 414 of carbon.
of dried starch, or facula..560.....440
of pure crystallized sugar..572.....428
of lignim, from boxwood....500 500

chiefly on the external parts, such as the leaves, flowers, fruit, &c., the number and diversity are very great, some of them calculated to delight the sight, the smell, or the taste; and others of the first utility in the arts, or in contributing to the subsistence or comfort of animal life.*

This slight notice of the phenomena of secretion, is sufficient to fill the mind with wonder and devout admiration in reflecting on the attributes of the Creator, exhibited in this familiar but most mysterious operation, by which the surface of the earth is replenished with food fit for the nourishment of living beings, adorned with beauty, and rendered fruitful of blessings. First, the sap is collected from the crude earth, consisting of common water, holding in solution a few well-known substances, which the soil abundantly supplies. This fluid is then carried through capillary tubes to the leaves, where it is, by some obscure chemical process, in which the light, heat, and gases of the atmosphere combine their secret powers, converted into a peculiar juice, corresponding to the constitution of each species of plant, and, in different species, possessing different and sometimes directly opposite qualities; such are volatile and fixed oils, resins, gum-resins, balsams, turpentines, tannin, and extractive, with alkalis and acids, earthy and saline compounds, &c. From this peculiar juice, again, are secreted substances, possessing apparently none of its characteristic properties which perform various important functions, and one of which is destined to form the particular tissue of the plant that exudes it, and to become, indeed, part of its substance,—thus, at one time moulded into the gnarled limb of the oak, and at another into the tender and pliant twig of the willow.

I cannot, without deviating too far from the popular plan of

* Supplement to Encyclopedia Britannica,—article Vegetable Physiology. M. Mirbel has lately made some observations on the cambium of vegetables, in which he confirms the opinion of Grew and Du Hamel, that all vegetable tissue has been cambium at first, or that mucilaginous matter, of extreme delicacy, which he, in other terms, names cellular mucilage.

this work, enter more minutely into the physiology of vegetable substances; but there is one well-known effect of the process of vegetation which I may just allude to, in order to call the reader's attention to a very remarkable adaptation with which it is connected. Dr. Priestley made the discovery, that oxygen gas is exhaled from the leaves of plants during the day, and the investigation which he commenced has since been continued by others,—the result of which is, that a species of respiration in plants has been ascertained, depending on the alternations of day and night, which is essential to their vital powers, the oxygen exhaled during the day being inhaled in the night. This affords us a new analogy between vegetable and animal existences, which is not a little curious; but let it be observed, that the object to be answered by this vegetable respiration, is exactly the converse of that which is answered by the breathing of animals; in the former, it is that of adding carbon, in an assimilated state, to the plant; in the latter, it is that of discharging the superfluous quantity of carbon from the animal.

There is something exceedingly worthy of remark in the fact just mentioned, as it exhibits a very unexpected, but most interesting view of the kind of action and reaction which goes on between the vegetable and animal creations, and of the salutary balance which is thus kept up in the two organized kingdoms. The oxygen exhaled during the day, completely compensates for that which was inhaled during the night; and, in whatever degree the atmosphere has been deteriorated, in its capability of sustaining animal life, by the discharge of carbonic acid from the lungs of animals, the demands of vegetable life for that injurious substance, tend again to restore it to a healthful state. 'The oxygen given out by plants,' says Dr. Roget, 'and the carbonic acid resulting from animal respiration, and from the various processes of combustion which are going on in every part of the world, are quickly spread through the atmosphere, not only from the tendency of all gases to uniform diffusion, but also from the action of the winds, which are continually agitating the

whole mass, and promoting the thorough mingling of its different portions, so as to render it perfectly homogeneous in every region of the globe, and at every elevation above the surface.'

Looking at the whole subject of vegetable physiology, even in the very imperfect outline of it which has now been traced, it is impossible not to recognize the Designing Hand of infinite power, wisdom, and goodness. The processes are so astonishing, the results so beneficial, and the adaptations so skilfully adjusted, that the man must be wilfully blind who does not see, in them all, the presence of a Father-God. Were but one of these to fail, or be deranged, disorder and destruction would inevitably ensue. And yet most of the changes and combinations of organic life are of the most delicate nature, depending upon conditions which a very slight deviation on either side would render nugatory; thus reminding us, continually, of the wisely regulated balance which the Creator has established, and sedulously preserves,—and teaching us the lesson of constant dependance on His providential care.

THIRD WEEK—TUESDAY.

FLOWERS.—THEIR FORM, COLOUR, AND FRAGRANCE.

The variety which exists in the vegetable world is an example of a quality which pervades all nature, and stands forth in each of its departments as a very conspicuous feature in the character of creation. There is a continued chain of existence, commencing with the most crude materials, and passing from earth, rocks, and metals, to the more subtle elements which compose water, air, and light; and thence again to vegetable productions, rising through the various tribes of mosses and fungi, to grasses, shrubs, and trees, till Nature combines all that is beautiful and delightful in this department of her works, in the formation of flowers. These,

though comparatively minute productions, yet contain in their construction, both as regards its appearance and its uses, so many proofs of beneficent intention, that there seems no part of the vegetable world which presents, in so concentrated a form, such varied evidences of a Divine Hand.

'Flowers may be regarded not only as the last, but the most elaborated organs of the vegetable system. Whether we contemplate the beauty of their forms, the splendour of their colours, or the delicious fragrance they every where breathe around us; or whether, with a physiological eye, we survey the delicacy of their structure, and investigate the peculiar functions they perform, we cannot but feel the greatest admiration of the skill with which, in a compass so small, and by means apparently so simple, such a series of actions, terminating in results so varied and important, can at once be combined and regulated.'* In this short but comprehensive description, two intentions of Creative Intelligence are indicated, the object of the one being to afford a source of innocent gratification to the senses, and that of the other, to contribute to some useful purpose, either in the economy of the plant itself, or as respects the animal creation. To the first of these objects, the attention of the reader shall be at present directed.

As a mere source of innocent gratification to the senses, flowers seem to be formed almost exclusively for the benefit of man. He alone, of all sentient beings, appears peculiarly formed to derive pleasure from a sense of the graceful and beautiful, or from the perception of a delicious perfume. The eyes of other animals are often even more acute than those of the human species, in distinguishing between what is hurtful or nutritious in their food, or in discerning between friends and foes, and in other means of self-preservation; while, to the same objects, their olfactory nerves are remarkably alive; and, doubtless, with the exercise of these instinctive or acquired feelings, much of the enjoyment of their lives is connected; but to those delicate sensations, connected, in some degree,

* Supplement Encyclopedia Britannica, Art. Vegetable Physiology.

with the mental faculties, and heightened by agreeable associations, which arise from the brilliancy and harmony of colours, from elegance of form, and from sweetness of odour, they seem to be in a great measure insensible. That there may, however, be a slight degree of enjoyment in some of the lower animals, arising from a bright colour, or a pungent smell, independent of the feelings already mentioned, I am not inclined to deny; but, in extent, and probably also in kind, it is certainly far inferior to the enjoyment derived by the human race from these sources; while, of the faculty which discerns the beauty of form and proportions, they appear to be wholly destitute.

On what principles in the human frame, either bodily or mental, these sensations depend, I shall not stop to inquire. Some very elaborate and ingenious treatises on taste, and the perception of beauty, are in the possession of the public; but it is sufficient for us at present to know the fact, that such sensations exist, and that they contribute in no trifling degree to the elegant enjoyments of human life, increasing and becoming more exalted in proportion to the progress of mental refinement. Assuming, therefore, the existence of these pleasurable feelings, of which every person must be sensible from his own experience, I am entitled to adduce the form, colour, and fragrance of flowers, as an instance of benevolent adaptation of a very remarkable, and, at the same time, a very satisfactory kind. The mind of man being made capable of deriving pleasure from certain forms and proportions in objects of vision, we find the very forms and proportions best calculated to excite this pleasure impressed in great variety on the multitudinous races of flowers. Their stalks, their leaves, the shape of their petals, are, in the vast majority of instances, such as to afford an agreeable sensation to the beholder, by gratifying that peculiar faculty which is known by the name of taste. A similar observation may be made with regard to the colour of flowers. The delicacy or brilliancy of their hues, the softness of their shades, the variety of their tints, sometimes contrasted, sometimes harmonizing, but almost al-

ways agreeable, prove, in the most satisfactory manner, design and adjustment between these appearances and the susceptibility of pleasure in the human mind. It cannot be said, with regard either to form or colour, that they afford indiscriminate gratification; for the mind is as capable of disgust from certain forms, and certain combinations of colours, as of enjoyment from others. There is in the case of flowers, therefore, an obvious selection of the agreeable, and rejection of the unpleasant, in both these particulars, which can only have proceeded from a desire in the Creator to communicate enjoyment.

A precisely similar mode of reasoning will prove benevolent design in adding fragrance to the other delightful properties of flowers. There seems no reason, in the nature of their constituent parts, why flowers should emit any smell at all; or, if they did, why that smell should be a sweet and grateful odour, rather than the reverse; but, in reference to the intention of an Intelligent Creator, the reason is obvious. It is one of the means by which Divine Benevolence enlarges the sphere of enjoyment to his rational creatures.

Nor must we forget, that the very union of all these agreeable properties in a whole class of vegetable productions, is itself an additional proof of kind intention in the Creator. Had only one of such qualities belonged to an individual species, while in other respects its properties were repulsive; had symmetry of form, for example, in one class, been accompanied with an unsightly colour, or a disagreeable scent; and, in another, had beauty of tints, or sweetness of fragrance, been united with deformity of figure, the pleasure would have been greatly diminished, if not totally counteracted. But the opposite of this usually occurs; and in such grouping of various agreeable properties, not naturally combined, we once more perceive an evidence of paternal care. This, again, is rendered still more palpable by the bountiful profusion, and inexhaustible variety, with which flowers are scattered on the green lap of spring. Wherever we wander, —in lawn, or field, or wood, or glade, over swelling hill, or

low-lying meadow, these gems of vegetation, in all their diversified loveliness, from the 'wee, modest, crimson tipped flower,' to the lily of the valley, arrayed in chaster beauty than Solomon in all his glory, as they spring up beneath our feet, arrest our gaze, and excite our admiration.

I persuade myself that it is not possible for any candid mind to resist the conclusion which flows from these combined particulars, that there is a Being of matchless skill, and condescending goodness, whose Hand may be traced even in the wild flowers of the desert; and whose perfections are not the less admirable, that He has lavished them on objects so minute and insignificant, and has cared, even in such comparatively unimportant matters as appearance and perfume, for the innocent gratification of his rational offspring. It is true, indeed, that we sometimes meet with a flower of a shape or odour which excites disagreeable sensations; and this is quite in accordance with the analogy of nature in a world where every thing is intended to remind us that we are fallen creatures, existing for a time in a blighted world; but in this, as in other departments of nature, benevolence vastly predominates, and a Father's care is conspicuous. It was not without reason that Mungo Park, in an hour of despair, was reassured by the sight of a little flower, looking forth in its loveliness from the soil of the wilderness; and that he received energy to effect his deliverance, by reflecting on that beautiful and comforting sentiment uttered by the Divine Saviour, 'If God so clothe the grass of the field, which to-day is, and to-morrow is cast into the oven, shall he not much more clothe you, O ye of little faith?'

THIRD WEEK—WEDNESDAY.

FLOWERS.—THEIR ORGANS OF REPRODUCTION, AND THEIR SECRETION OF HONEY.

Besides the properties of form, hue, and fragrance, which I noticed yesterday, as belonging to flowers, these lovely and

curious productions are made to perform some highly important functions as respects the economy of the plants themselves, as well as in reference to the animal world.

The corolla—or, in popular language, the flower—surrounds those delicate organs on which the reproduction of the plant depends, and consists of one or more petals, which are placed within a calyx, or flower-cup, generally of leaflets. Its physiological use is various. Its petals are found to abound in air-vessels, and to form carbonic acid gas, though they do not decompose it, like the leaves; and hence they have been called by Dr. Darwin, the lungs of the generative organs, while the leaves may certainly be held to perform to the rest of the plant a function analogous to that of lungs. The best ascertained office, however, which the corolla executes, is that of protection to the organs of reproduction, which are enclosed by it. For this purpose it is obviously contrived. Amidst the most striking elegance and variety of shape in the different species, this function is never lost sight of. It opens its bosom to the sun, and sometimes turns towards him, and follows his course as he moves through the heavens, or, more frequently casts its look directly upwards, that it may receive its vivifying rays from whatever quarter he shines. It is often so formed that it may wave in the wind, to favour the prolific process by its agitation, and that it may turn away its face from the blast, when it would breathe too roughly on the precious charge. In the evening, or in rain, or even sometimes when the sun is obscured by clouds, if the parts it guards are so delicate as to be injured by the cold or wet, it carefully shuts its petals, to open them again whenever the cause of alarm is removed;* in all these operations exhibiting a very interesting proof of paternal care in the Creator.

With regard to the reproductive organs themselves, the same care is displayed. By a series of very striking contri-

* During the annular eclipse of the sun on May 15, 1836, which happened not long after mid-day, while that luminary was shining in full power, flowers were observed to shut their leaves, and some of them reopened when the eclipse was over.

vances, differing materially in different kinds, and, in all these varieties, affording new proofs of Designing Wisdom, the continuance of the species is secured, while individuals perish; and thus the principle which pervades all organized existences, of alternate decay and revival, is provided for. The analogy of nature, too, in the mode of this, as well of other processes, is remarkable. As in the animal, so also in the vegetable world, the reproduction of the species is effected by means of organs called male and female,—barren when kept separate, but rendered fertile by their union. The male organ has obtained the name of stamen, that of the female the name of pistil.* From the Edinburgh Encyclopedia the following account of their functions is abridged.

Botanists are now generally agreed as to the real nature and extent of the offices which the stamens and pistils are destined to perform in the economy of Nature. Linnæus has the distinguished merit of having clearly and satisfactorily established that they are organs essential to the propagation and perfection of the fruit. The proofs adduced in favour of this opinion are highly satisfactory. Every one must have observed that the flowers precede the fruit, and this holds true throughout the whole classes of plants. Now, all flowers are furnished with both stamens and pistils, either in the same individuals, or in two distinct individuals of the same species. This fact has been ascertained in the most minute examples, even in mosses, which were long supposed anomalous. Ferns form the only apparent exception; and it is highly probable, from general analogy, that these parts, though still concealed, have existence in that order. The most decisive proof of the

* The following is a more particular account of the organs of reproduction. The germ is lodged in a vessel called the *ovary*, or seed-vessel. From its summit rises a little thread-like stalk, called a *style*, which, at its extremity, supports a small spongy substance, denominated the *stigma*. These three form a whole, which bears the name of *carpel*. Immediately surrounding the *pistils* are situated the *stamens*, each of which consists of a slender filament, supporting a little bag or case, called an *anther*, filled with *pollen*, which is a species of dust or powder. The anthers, when ripe, burst, and shed their pollen upon the stigma.

necessary agency of the stamen on the pistil, for the production of the perfect fruit, is afforded by the very well-known experiment made in 1749, upon a small palm-tree at Berlin, which, for the want of the neighbourhood of a male tree, had never brought any fruit to perfection. A branch containing male flowers was sent by post from Leipsic, a distance of twenty German miles, and suspended over the pistils. Subsequently abundance of fruit was ripened, and many young plants raised from the seeds.* Another instance, still more remarkable, but, from the nature of the case, less capable of being distinctly established, is mentioned by some authors, relating to two remarkable palm-trees in Italy. The one, situated at Otranto, had no stamens; the other, at Brindisi, which is about forty miles distant, had no pistils; and, consequently, neither of these trees bore seed. But when, after the growth of many years, they not only rose superior to all the trees of the neighbouring forests, but overtopped all the buildings which intervened, the pollen of the palm-tree at Brindisi, was wafted by the wind to the pistils of that of Otranto; and to the astonishment of every one, the latter bore fruit.†

It is remarkable that in flowers which possess both the male and female organs the stamens are, with very few exceptions, shorter than the pistils in drooping flowers, and longer in those that are erect; evidently destined, in both cases, to favour the influence of the pollen. Many other curious and beautiful means are employed to promote the due application of the pollen to the stigma. In some plants, such as the *Parnassia*, the stamens successively lean over the stigma, and deposit the pollen; others are invested with a power of consentaneous junction between these parts; others are connected with a membrane, which contracts and dilates according to the state of the atmosphere. Some stamens possess a considerable elasticity, by which means the pollen is projected upon the stigma; in other flowers the germen has a cur-

* Edinburgh Encyclopedia, article Botany, pp. 67, 68.

† Fifth Book of Lessons for the Use of the Irish National Schools.

vature endowed with an elasticity which brings it into contact with the stamens.

Bees, and other insects, are frequently the agents in fertilizing the stigma. The object of the animal is to obtain honey; and while in quest of it, his hairy body collects the pollen from the male flower, and communicates its influence to the female, during some subsequent search. If it be true as is said, it is not a little singular that these insects, which are not confined to a particular species of plants, fix upon one species during the course of each day. In those flowers which require their agency, hairs are usually placed in such a situation at the entrance of the flower, as not only to exclude the wet, but also to compel all insects that enter it to pass over the stamens. The intervention of insects is strikingly displayed in the *aristolachio climatitis*, the flower of which always remains in an erect position, although the stamens are shorter than the pistils, forming an exception in this respect, to the general rule; the consequence of which is, that the pollen falls to the bottom of the flower, where it would remain useless, as has been proved by experiment, were it not for these living agents. Many particulars are recorded by Keolreuter and Springel, of the means by which different insects are made unconsciously to accomplish these ends, exhibiting a new series of creative adaptations between the animal and vegetable worlds; but though these are exceedingly interesting, I cannot at present stop to enter on them.

The last function of flowers which I shall notice, relates to their use to the insect tribes, already incidentally hinted at. The nectaries of flowers seem to be intended by Providence for the secretion of honey, that well-known and delicious substance, which forms the food of the bee and numerous other insects. From the position of this organ at the bottom of the corolla, and below the parts of reproduction, the intention of which, at least in some instances, we have already seen, it is not easy of access, and would indeed frequently be altogether inaccessible, had not the same Divine Hand which laid up the precious store for them, furnished

them with peculiar instruments, with which, after finding their way to the bottom of the deep cup, they can pump up their food—another pleasing instance of adaptation between the animal and vegetable worlds.

A pious acquaintance, remarkable for the quaint shrewdness of his observations, having one day pulled a primrose from a hedge side, after expressing his admiration of its simple beauties, took up a clod in his other hand, and naïvely, but emphatically exclaimed, 'What but Almighty power could extract *that* from *this?*' If there was any thing ludicrous in the manner there was nothing but truth and sublimity in the sentiment. Every thing in the operations of the Creator is worthy of devout admiration; but I scarcely know any thing in the inanimate world, which brings together and concentrates so many wonders of designing wisdom and benevolence, as the structure and qualities of a flower;—and assuredly not a little is added to the surprise and pious feeling with which this delightful production is contemplated, when we think of the crude materials from which it is elaborated. The beauty of form and colour; the sweetness of the fragrance; the delicate and skilful nature of the organization; the careful provisions, the forethought, the contrivance, the suiting of parts, as regards the propagation of the species; the adaptations to the subsistence and enjoyment of the insect tribes—all produced by the artificial union of a few simple and apparently unfit substances, cannot fail to excite in the reflecting mind the most lively sentiments of astonishment, and to force upon it the conviction, that here, without doubt, is the finger of God.

THIRD WEEK—THURSDAY.

THE VIOLET.

To attempt to particularize the various beauties of that profusion of flowers which Spring scatters around us, would be

altogether inconsistent with the nature of the task I have assigned myself. An individual instance must suffice, and with that, a friend, to whom I am indebted for several other interesting papers, has been kind enough to supply me.

All who delight in finding a beauty and a meaning even in the wildest flowers, must have often hailed with the liveliest pleasure that flower of flowers, the exquisitely formed and scented violet. By the dusty wayside, by the green border of the brook, or on the sequestered woodland bank, this universal favourite gives its delicate blossoms to the breeze, recumbent on a mossy bed, or modestly peeping forth from the rank herbage and weeds. As it is a creeping plant, and throws out runners which take root in the soil, and form new stems, it is most commonly met with in beds that make the whole bank or mound odorous and beautiful. Sometimes, however, we find, by the retired footpath, or on the lonely hillside, a single flower blooming alone, the survivor, perhaps, of its fragrant compeers, or the forerunner of a numerous progeny. Then occur the beautiful lines of the poet:—

'A violet by a mossy stone,
Half hid from human eyes;
Clear as a star, when only one
Is shining in the skies.'

The stalks of the wild sweet violet are round, of a green colour, and creep along the surface of the ground, seldom becoming erect. The leaves are also green, and rather large for the size of the plant. They are shaped like a heart, are slightly indented round the edges, and usually hang down in a drooping posture. The flower consists of five petals or leaves, and presents in various mixtures every variety of yellow and blue. A delicate purplish tinge, which it sometimes assumes, adds greatly to its beauty and richness. Four of the floral leaves are disposed in the form of an oblong, the fifth projecting from one of the longer sides, in the direction of the ground. The whole flower is defended by a five-leaved *calyx*, or cup, and hangs down from the gracefully bent stem, a perfect emblem of modest loveliness.

We all admire the beauty of the violet, and delight in its perfume. We are also familiar with its praises, and with its moral and poetical associations. But, while we feel and own the poetry of the flower, have we ever reflected on the admirable specimens of Creative Intelligence which it furnishes, and the numerous beneficial purposes to which it is subservient? Let us attend to the mode in which its seed is protected and spontaneously sown. This seed is formed in a *capsule*, or seed-vessel, with three valves, each containing about an equal number of the tender germs. During the process of ripening, the seed-vessel hangs in a perpendicular position, and is defended from any excess of moisture by the natural umbrella of the calyx. When the seed is nearly ripe, the containing vessel shrivels and begins to open, and, from the shrinking and consequent erection of the stem, the whole apparatus gradually assumes an upright position, in which the capsule, instead of being shielded by the calyx, is supported by it. But why, it may be asked, should not the seed fall at once from the opening vessel without being elevated to an upright and higher position, where its timely dispersion appears to be a matter of greater difficulty? Let us not judge hastily, but inquire further into this interesting subject. From the gradual evaporation of moisture, the sides of the valves shrink and roll up, and the sharp edges of each, at this stage, pressing upon the contained seeds, bring them, though previously arranged in a very irregular manner, into nearly a straight line. Each seed is of an oblong shape, and is hard, smooth, and shining; and hence, when the infolding edge of the shrivelling valve presses upon it, and slides down behind it, the pressure throws it out with a jerk to a distance proportioned to its elevation above the ground. Now may we see the reason why, previous to the scattering of the capsule's contents, that vessel is considerably elevated, as by a mechanical agency contrived for the purpose. The seeds, projected from an increased elevation, are dispersed through a wider circuit, and thereby more effectually fulfil the object of their formation. With such wonderful skill is the mechan

ism of a single flower constructed, and with such admirable precision does it accomplish all its purposes. Thus, also, do flowers not only charm the eye, and inspire poetic emotion, but, marvellously contrived, as well as clothed with beauty and perfume, they furnish the understanding with objects worthy of its highest powers. Their structure displays the infinite skill, no less than their outward attractions, the benevolence of the Creator. Surely the knowledge of those arrangements, by which the seed of the violet is perfected and dispersed to most advantage, must greatly enhance its matchless sweets in the eyes of every intelligent lover of Nature.

The violet is not without its utility in the economy of the natural world. That a thing exists is sufficient of itself to prove to every pious and philosophic mind that it is useful: but in the case of this much observed flower, we can easily show a few of its specific uses. The caterpillars of several species of butterflies, feed exclusively upon its stalks and leaves during summer; and caterpillars, destructive though they be, and often fatal in their ravages, are yet subservient to the wise purposes of preventing the excessive propagation of certain plants, and of feeding numerous tribes of birds. In winter the stalks afford a secure deposit for the grub of a gall-fly, the insect that produces the oak-galls, so valuable in commerce. In the course of the summer or autumn, the fly lays its eggs on a growing violet-stalk, and the young grubs, as soon as they are hatched, eat their way into the interior, where they find food and protection till the warm weather arrives. The ascending juices being interrupted by their operations, the stalk swells around them to a considerable thickness; but by this disfiguration of the plant, their food is only the more increased, and they are better secured against the cold. On the return of summer, they bore their way out of their vegetable prison, and make their escape in the adult shape of flies.

The violet, like most other plants, may be employed in medicine. It is deservedly a favourite in every rustic pharmacopeia. An excellent syrup is made from its flowers; its

dried leaves furnish us with numerous useful decoctions and ointments; and an infusion of its seeds operates as a remedy for several severe diseases. Thus it is full of healing virtue, in addition to its other useful properties.

Now, the violet is but a specimen of the innumerable wild flowers that adorn the exuberant lap of Nature, and pour forth their treasures to man, while they feed his eye with the purest delight. Were human labour wholly to cease in respect to flowers, and the garden and flower-bed henceforth to lie desolate, still would every sunny and shady nook teem with glowing and perfumed blossoms,—still would the loneliest wilds be crowned

'With luxury of unexpected sweets,'

and exhibit the most delicate specimens of the beautiful, traced by His hand, who is himself the perfection of beauty. Boundless are the vegetable stores with which the earth is strewn; and their extent is only equalled by their utility and loveliness. They all proclaim a great and benevolent Creator:—the majestic oak and the lowly violet of the vale, utter one harmonious voice of praise. Our duty is to listen to that voice with joy, and add our own intelligent adoration.

J. D.

THIRD WEEK—FRIDAY.

THE ANIMAL STRUCTURE.—CELLULAR TEXTURE—MEMBRANES, TENDONS, AND LIGAMENTS.

Reserving to the subsequent seasons what yet remains to be said of the varieties of the vegetable creation, let us now turn our eye on the animal kingdom. The functions of animated nature differ from those of vegetation, not merely in the higher energies of sentient beings, but in other circumstances of their condition, suited to their more exalted station in the scale of existence. Vegetables are fixed to a spot from which they derive their nutrition, and where their reproductive powers are called into action; and to these purposes alone, if we except their relation to the animal world, their structures are adapted.

But, besides the powers of nutrition and reproduction, the faculty of volition, and those of personal enjoyment and suffering, belong to animal life. The exercise of these qualities required a greater range of space; and accordingly, animated beings,—those of them at least in whom such powers are fully developed,—are not attached to a single spot, but are formed capable of locomotion. This change of condition rendered various corresponding changes necessary in their organization; and it is exceedingly edifying to observe the nature of these changes, as manifesting at once unity of purpose, and most skilful adaptation to circumstances, in the universal Creator.

'The element,' says Dr. Roget, 'which we recognize without difficulty, as composing the greater portion of animal structures, is that which is known by the name of the cellular texture. Although bearing the same designation as the elementary material of the vegetable fabric, it differs widely from it in its structure and mechanical properties. It is not, like that of plants, composed of a union of vesicles, but is formed of a congeries of extremely thin laminæ, or plates, variously connected together by fibres, and by other plates, which cross them in different directions, leaving cavities or cells. These cells, or rather intervening spaces, communicate freely with one another, and, in fact, may be considered as one common cavity, subdivided by an infinite number of partitions, into minute compartments. Hence the cellular texture is, throughout, readily permeable to fluids of all kinds, and retains these fluids in the same manner, and on the same principle, as a sponge.'*

This texture is not only flexible in all directions, but highly elastic, and is thus admirably suited to the purposes of locomotion, to which the vegetable tissue could not be advantageously applied, as the nature of its formation, while it admits, indeed, of very considerable flexibility in the direction of its breadth, and also to a certain extent, of elasticity and the power of extension, is yet comparatively rigid in other

* Bridgewater Treatise on Animal and Vegetable Physiology, vol. i. p. 99.

directions. The properties of flexion and extension, existing in the animal texture, are variously modified and adjusted, to suit the exigencies of the case. 'When, for instance, different parts require to be moveable on each other, the cellular substance interposed between them, has its state of condensation adapted to the degree of motion required; that which connects the muscles, or surrounds the joints, and all other parts concerned in extensive action, has a loose texture, being formed of broad and extensible plates, with few lateral adhesions, and leaving large interstices; while, in the more quiescent organs, the plates of the cellular substance are thin and small, the fibres short and slender, and their intermixture closer and more condensed.' The quality of elasticity, again, not only resists the displacement of parts, but, when displaced, causes them to possess a tendency to return to their natural position, and that in a degree, and to an extent, which is neither required nor possessed in the vegetable mechanism.

When it is necessary to interpose a barrier to the transmission of fluids, this is effected by *membranes*, which are merely 'modifications of the same material, spread out into a continuous sheet, of a closer texture.' These furnish strong coverings for the investment, the support, and the protection of all the important organs of the body.

Such membranous textures are also employed in forming tubes for conducting fluids, which, in the higher classes of animals, traverse the body in innumerable canals, and which, when uniting into trunks, or subdividing into branches, are called vessels. The fluids contained in vessels are never stagnant, but are almost always carried forward in one constant direction. For preventing the retrograde motions of fluids passing along these canals, recourse is had to the beautiful contrivance of valves. The inner membrane of the vessel is employed to construct these valves; for which purpose, it is extended into a fold, having the shape of a crescent, and fixed, by its convex edge, to the sides of the vessel, while the other edge floats loosely in its cavity. Whenever the fluid is impelled in a direction contrary to its proper course, it

raises the loose edge of the valve, which, being applied to the opposite side of the canal, effectually closes the passage. On the contrary, it presents no obstacle to the natural flow of the contents of the vessel, both edges being then closely applied to the same side. Frequently two, or even three, valves are used at the same part, their edges being made to meet in the middle of the passage, like the flood-gates or locks of a canal. Among the numberless instances of express contrivance, which are met with in the examination of the fabric of animals, there is perhaps none more striking and more palpable than this admirable mechanism of the valves.

To this general sketch of the fleshy and membranous structure of animals, I may add that of *ligaments* and *tendons*, some of which are elastic and extensible, while others resist extension with great force. The former, consisting of twisted fibres, are generally employed for the support of heavy parts, which require suspension, such as the necks of quadrupeds which stoop to graze;* the latter, which are most artificially contrived, by the interlacing and knotting together of fibres, are applied to the purposes of connexion, where motion is to be restrained. Nothing can be more remarkable than the ingenuity, if I may be allowed to use the expression, of these contrivances, and the adaptation of their mechanism to the purposes to which they are respectively applied. The precise degree of tension, of strength, of elasticity, or the contrary, which the function required, has been apportioned with the most perfect skill; and it is impossible to examine these structures with a scientific eye, and not acknowledge that there is a wisdom here, which art may imitate, but can never equal.

* This ligament is what butchers call the *pax-wax*. Dr. Paley is mistaken, when he says, that these elastic ligatures are peculiar to the necks of quadrupeds. They are frequently employed in the human frame. 'The student,' says Sir Charles Bell, 'who hangs his head over his book, enjoys the advantage of this elastic support; so that it is strictly a matter comparative. We may trace it with increasing strength, from the ligament which sustains a man's head, to that which, like the spring of a steel-yard, weighs against the immense head of the elephant.'

THIRD WEEK—SATURDAY.

THE ANIMAL STRUCTURE.—SECRETION—DIGESTION—AND THE CIRCULATION OF THE BLOOD.

THERE is another property of animal life, which, on account of its universal application, and its absolute necessity, seems to demand some notice in these preliminary sketches; —I mean the function of *secretion*. This capability of effecting chemical changes in the crude materials received into the body, I have already described as existing in vegetable life; but, in the animal frame, it is much more extensive and powerful. The food of plants is drawn directly from the soil in which their roots are placed, and the atmosphere with which they are surrounded, and consists of simple combinations of elementary bodies, which secretion converts into the various products that their wants require. From this process, the tree receives its leaves, its pith, and its woody fibres. Whatever is peculiar to the species is also derived from the same source. The sweet perfume and delicate hues of the flower, the oil of the olive, the milk of the cocoa-nut, the sugar of the cane, the narcotic juice of the poppy, the nutritious farina of the cereal tribes, and the poisonous extract of the nightshade, are all elaborated by the same mysterious process, and from similar, if not the very same, materials.

In the animal world, the secreting power is carried to a still more wonderful extent, and is applied to a far greater variety of purposes, corresponding to the more complicated and delicate organization of the frames it is destined to support. One remarkable condition of animal food is, as already noticed, that it shall have previously either formed a portion of some other organized being, or, at least, have been a product of organization; and hence the use of the vegetable creation to animal life. But, though no inorganic substance, perhaps, can be considered as capable of affording food directly to the higher order of existences, there is scarcely any animal or vegetable matter, however dense its texture, or virulent its qualities,

which is not convertible, by the power of digestion and secretion, into nourishment for some one or other of the various species of animals. The very venom of the rattlesnake is harmless in the human stomach, and the acrid matter of cantharides, which so readily blisters the skin, forms the natural food of some species of insects.

The various processes by which animal nutrition is carried on, are exceedingly curious, and full of edification, as indications of Creative Intelligence. As the food is not to be received now directly from the soil by means of roots, a mouth is provided, through which it is conveyed, after mastication, into the stomach, where it undergoes the process of digestion. It is thus converted into a pulpy substance, called *chyme*, by the chemical properties of the *gastric juice*, a secretion from the coats of the stomach. Hence it is carried into the intestinal tube, where, by being subjected to further chemical agents, it undergoes a new transformation into *chyle*,—a fluid perfectly bland, and unirritating in its properties. It has now been brought into that precise state of composition, which renders it fit to be distributed to every part of the system, for the purposes of nourishment. From the inner surface of the intestines, the chyle is absorbed by the lacteals, which commence by very minute orifices, in incalculable numbers, and unite successively into larger and larger vessels, till they form trunks of considerable size. They pass between the folds of a very fine and delicate membrane, called the mesentery, where the chyle undergoes the action of certain glands, in which it is supposed to receive some additional modification by the secreting process, preparatory to its conversion into blood. It is then conducted into a common receptacle, whence it ascends, through the thoracic duct, along the side of the spine, till it passes into the great veins leading directly to the heart. It is now blood, and, by the remarkable apparatus of the heart, which I must not stop to describe, is propelled into the general circulation, and conveyed to every part of the body, being, in the higher species, aerated in the lungs, to complete the necessary change, to restore its vital properties

when these become contaminated, and probably to assist, by the decomposition of the atmosphere, that animal warmth,* so essential to the various processes of life. It is during this circulation, that those actions of secretion take place, by which every part of the animal frame, however diversified, is nourished, developed, and repaired. 'All the modifications of cellular substance, in its various states of condensation,—the membranes, the ligaments, the cartilages, the bones, the marrow; the muscles, with their tendons; the lubricating fluid of the joints; the medullary pulp of the brain; the transparent jelly of the eye;—in a word, all the diversified textures of the various organs, which are calculated for such different offices, are derived from the same nutrient fluid, and may be considered as being merely modified arrangements of the same ultimate chemical elements.'†

This series of preliminary observations on the animal functions, may be fitly concluded in the words of an author, whom I have chiefly consulted in the physiological department of my subject. 'Although the order in which the constituent elements of organized products are arranged, and the mode in which they are combined, are entirely unknown to us, we can nevertheless perceive, that, in following them successively from the simplest vegetables to the higher orders of the animal kingdom, they acquire continually increasing degrees of complexity, corresponding, in some measure, to the greater refinement and complication of the structures by which they have been elaborated, and of the bodies to which they are ultimately assimilated. Thus plants derive their nourishment from the crude and simple materials which they absorb from the earth, the waters, and the air that surround them,—mate-

* That animal warmth has been accounted for by the combination of oxygen with the carbon of the blood, which takes place in respiration, occasioning heat, as in actual combustion, where a similar process occurs, and being diffused over the body, during the circulation of the blood, was long maintained by physiologists. This doctrine, however, has of late been considerably modified: and, it is now believed, that, although the chemical cause operates, to a certain extent, much of the effect is dependant on the influence of the nerves, and the mysterious principle of life operating by them.

† Roget's Bridgewater Treatise, vol. ii. p. 345.

rials which consist almost wholly of water, with a small proportion of carbonic acid, and a few saline ingredients, of which that water is the vehicle. But these, after having been converted, by the powers of vegetable assimilation, into the substance of the plant, acquire the characteristic properties of organized products, though they are still the simplest of that class. In this state, and when the fabric they had composed is destroyed, and they are scattered over the soil, they are fitted to become more highly nutritive to other plants, which absorb them, and with more facility adapt them to the purposes of their own systems. Here they receive a still higher degree of elaboration; and thus the same materials may pass through several successive series of modifications, till they become the food of animals, and are then made to undergo still further changes. New elements (and, in particular, nitrogen) are added to the oxygen, hydrogen, and carbon, which are the chief constituents of vegetable substances; and new properties are acquired from the varied combinations into which their elements are made to enter, by the more energetic powers of assimilation appertaining to the animal system. The products which result are still more removed from their original state of inorganic matter; and, in this condition, they serve as the appropriate food of carnivorous animals, which generally hold a higher rank in the scale of organization, than those that subsist only on vegetables.

'Thus has each created being been formed, with reference not merely to its own welfare, but also to that of multitudes of others, which are dependant on it for their support, their preservation,—nay, even for their existence. In contemplating this mutual relationship, this successive subordination of the different races to one another, and this continual tendency to increased refinement, we cannot shut our eyes to the magnificent unfolding of the great scheme of Nature, for the progressive attainment of higher objects; until, in the perfect system and exalted endowments of man, we behold the last result which has been manifested to us of Creative Power.'*

* Roget's Bridgewater Treatise, vol. ii. pp. 13—15.

FOURTH WEEK—SUNDAY

'THE SAME LORD OVER ALL.'*

On this returning Sabbath, let us reflect upon the power of God as displayed in the works of his hands. In the words of Scripture, he is 'the same Lord over all.' He is the Creator, the Preserver, and the Governor of the Universe. Ere he summoned this earth into existence, He reigned on high in sovereign majesty. There is, and ever shall be, no rival near his throne; for he 'was, and is, and is to come,' the 'King eternal, immortal, and invisible,—the only living and true God, inhabiting eternity and its praises, whose name alone is holy,' and who is 'without variableness or shadow of turning.'

He sent forth his creative word, and this solid earth arose. His Spirit had brooded 'upon the face of the waters,' and the restless ocean heaved back its tumultuous surges from off the dry land. Then vegetation, in all its varied beauty, was spread abroad over the surface of our globe,—from the stately monarch of the woods, down to the humblest flower that decks the streamlet's side. And every thing in which is the breath of life, was ushered into existence; the beast that roams in the forest,—the bird that cleaves the vault of heaven,—the tiny insect that glitters in the sunbeam,—and the finny tribes that seek their way through the watery depths. And, lastly, man was formed,—his body from the dust of the ground,—his soul in the image of his holy Maker. All these, varied and wondrous though they be, owe their origin to the will of one Almighty and Eternal Spirit,—'the same Lord over all.' Unlike the works of man, the works of Nature are stamped with a character which speaks of the power, and the wisdom, and the goodness of a presiding Deity. The noblest specimens of human art, imperfect after the improvements of many generations, must yield to decay. The most ingenious mech-

* Rom. x. 12.

anism which human skill can devise, formed as it is out of the materials afforded by nature, must fail, and perish beneath the hand of time. But it is not so with the works of God. Perfection is inscribed on every one of them. They endure until they have fulfilled the immediate purposes of their formation; and even when, to us, they may appear to be destroyed, they do, in reality, but alter their form and position, that they may take a part in other processes of nature, no less wonderful, and no less demonstrative of the power, and wisdom, and goodness, of the same unchangeable Creator. The tree loses its beauty, when the breath of autumn has stripped it of its foliage. Yet even then, it is only resting, as it were, that it may put forth its renewed energy in all the loveliness of opening spring. The blossom must wither and die; but it is only that it may give place to the more precious and more valued fruit. The fruit also must be shed, and must decay; but it is that the seed, being brought to maturity, may be buried in the earth. And there, while hidden from our sight, and where, but that experience teaches us otherwise, we might deem that it was lost for ever,—a living energy is at work, although we see it not, which will bid it come forth, to bud, and bloom, and flourish, in its appointed season.

This is but one proof, amidst a countless multitude, that it is the 'same Lord' who 'ruleth over all.' From the minute were we to turn to the vast, we should find the same truth inscribed on universal nature. Not only do the elements of earth harmonize with each other so as to exhibit one uniform design pervading the whole, and one infinite Mind fitting them to each other by measured and balanced laws,—but, if we cast our eye beyond the bounds of this little sphere, we shall find the very same simple but efficient powers and material properties regulating the most distant worlds, as well as those which belong to our own system. Their light is the same, their attracting forces are the same, their laws of motion are the same; the same mighty plan wheels them in circles round some common centre. While there is something exceedingly satisfactory to the human mind to know the uni-

versality of the powers impressed on nature, and the sameness or its arrangements, it assuredly elevates our conceptions of human ingenuity to be made aware that, by employing the endowments bestowed on him by his Maker, he has been able to demonstrate this truth.

We are, therefore, well warranted to conclude, that there is one Infinite Creator, and only one, who ruleth over all,—over all material agents, and over all immaterial agents, whatever these may be. How vast, then, must be the extent of his empire. From the earth to the sun; from the sun to the most distant visible star; and farther still,—far, far beyond the ken of mortals,—throughout space without bounds,—throughout duration without beginning and without end, He reigns. 'The heavens declare his glory, and the firmament showeth his handiwork.' While the celestial hosts move in beauty and brightness in the way He has prescribed, they proclaim 'their great original.'

And this eternal God rules over the children of men. He has opened to us a view of the world of spirits, and has assured us that we are under training for the society and functions of the higher beings, of whose existence He has made us aware. 'This mortal must put on immortality, and this corruptible incorruption.' He is Lord, also, of the spiritual world. Of old, He created the Heaven of heavens, where He reigns in unclouded majesty, surrounded by cherubim and seraphim, angels and archangels, the holy and happy spirits whom He has formed, that they may 'serve Him day and night continually.' Here is His more immediate presence. This is the region of taintless purity and of unfading loveliness; into whose blessed realms of life and light, death and sin can never enter; and from whose remotest borders sorrow and sighing are for ever excluded. It is this happy country which is the inheritance of the Redeemed; and into its highest glories they shall be ushered, when the last trumpet shall marshal their dead bodies, that they may exchange the darkness and corruption of the tomb for everlasting brightness and unwearying bliss.

He is Lord also, of the powers of darkness. Hell is the place of banishment which He has formed for the transgressors of his law, and rebels against his authority. There also He reigns; but it is in awful, wrathful, frowning majesty. With the inhabitants of this dread abode the ungodly among the children of Adam are destined to associate. 'Their worm dieth not, and their fire is not quenched.' The smoke of their torment ascendeth for ever. But in no instance is misery the rule of God's government; it is only the exception. 'How vast soever the kingdom of darkness may be, in itself considered,' says an eloquent divine, 'it is certainly nothing more than the prison of the universe, and small, indeed, compared to the realms of light and joy.* The misery of that unholy community, when the eye is fixed upon that only, fills the soul; but when from this dreadful exhibition of sin, and display of justice, we raise the adoring eye to God, reigning throughout his boundless dominions, and rejoicing in their joy, the world of misery shrinks to a point, and the wailings of the damned die away, and are lost in the song of praise.'† J. R. D.

FOURTH WEEK—MONDAY.

ANIMAL STRUCTURE.—THE GASTRIC JUICE—MUSCULAR POWER—NATURE OF THE PROOF OF CREATIVE WISDOM DERIVED FROM THE ANIMAL FRAME.

'When we speak of an organ as peculiarly suited to exhibit design,' says Sir Charles Bell, 'we mean merely that

* Let it be observed, that this determines nothing as to the relative numbers of the redeemed and lost, as regards this world. The benevolent character of the Creator is vindicated, if, in the whole connected system of the universe, happiness predominate.

† Sermon on the Government of God, by the Rev. Lyman Beecher, of East Hampton, Long Island.

we comprehend something of the object of the particular structure:—But there is no part of an animal, if we fully comprehended what was necessary to the performance of its functions, that would not raise our admiration. Were we to take a portion of the skin, and contemplate its extreme sensibility, so finely apportioned,—could we penetrate, as it were, into the pores, and duly estimate the power, which regulates the secretions and absorption,—could we fully understand the relations of this organ, either with the economy of the body within, or the constitution of the atmosphere without,—we should have no occasion to draw our argument, for the twentieth time, from the structure of the eye or the ear. Were we to take one cell of the millions of that substance which, intervening between the more solid textures of the frame, gives elasticity to the whole, and permits circulation and muscular action, and all the various movements of the body, we should have, in that one cell, as much reason for wonder at the perfection of the contrivance, as in any joint of the limb.'*

These weighty observations come with peculiar force from an anatomist and physiologist of such well-earned celebrity, and show, at a single glance, the indefinite extent of the subject to which we are now slightly adverting. It leads us also to perceive why certain parts of the organized frame are more clearly discerned to be skilfully contrived than other parts. It is because the former more strictly correspond with a mechanism, or with processes of which we have examples in the arts, or with which science has made us otherwise acquainted. Our imperfect knowledge allows us frequently only a glimpse into a world of wonders. And this is the case with the contrivances which formed the subject of Saturday's paper. We see enough, however, even in that superficial sketch, to convince us, that were we to penetrate deeper, the Divine perfections would be exhibited more and

* Note to Paley's Natural Theology Knight's edition, 1836. Pp. 99–101.

more clearly, just in proportion to the enlargement of our powers of perception.

Dr. Paley has given a very striking instance of the kind of ignorance to which I allude, and draws the precise limit to which the nature and extent of our knowledge confines us. 'There is,' says he, 'what may be called the chemical part of our frame, of which, by reason of the imperfection of our chemistry, we can attain to no distinct knowledge; I mean, not to a knowledge, either in degree or kind, similar to that which we possess of the mechanical part of our frame. It does not, therefore, afford the same species of argument as that which mechanism affords; and yet it may afford an argument in a high degree satisfactory. The gastric juice, or the liquor which digests the food in the stomach of animals, is of this class. Of all the *menstrua* it is the most active, the most universal. In the human stomach, for instance, consider what a variety of strange substances, and how widely different from one another, it in a few hours reduces to a uniform pulp, milk, or mucilage. It seizes upon every thing; it dissolves the texture of almost every thing that comes in its way. The flesh of perhaps all animals; the seeds and fruits of the greatest number of plants; the roots, and stalks, and leaves of many, hard and tough as they are, yield to its powerful pervasion. The change wrought by it is different from any chemical solution which we can produce, or with which we are acquainted, in this respect, as well as in many others, that, in our chemistry, particular menstrua act only upon particular substances. Consider, moreover, that this fluid, stronger in its operation than a caustic alkali, or mineral acid,—than red precipitate, or aquafortis itself,—is nevertheless as mild, and bland, and inoffensive to the touch or taste, as saliva, or gum-water, which it much resembles. Consider, I say, these several properties of the digestive organ, and of the juice with which it is supplied, or rather with which it is made to supply itself, and you will confess it to be entitled to a name which it has

sometimes received, that of *the chemical wonder of animal nature.**

Now, although we are ignorant of the composition of this fluid, and of the mode of its action, this ought not to hinder us, as our author justly argues, from acquiescing in the inference, which a production of nature, by its place, its properties, its action, its surprising efficacy, its invaluable use, authorizes us to draw in respect of Creative Design.

This kind of observation may be very extensively employed, as it is applicable, not merely to the chemical, but to the mechanical parts of the animal frame. We perceive the mechanical law, and know that, when operated upon in a particular way, certain effects must occur, which effects we see actually produced; but then we are altogether ignorant of the mode by which the organ in question is brought into operation. An example of this we find in the construction of a muscle. The peculiar property which characterizes the muscular fibre is that of suddenly shortening itself, so as to bring its two ends, and the parts to which these ends are attached, nearer to each other. This contraction is performed with astonishing quickness and force, and the accumulated effect of a large collection of these fibres, such as constitutes a muscle, is therefore capable of overcoming great resistances, or of raising enormous weights. There is nothing like this power in the vegetable kingdom; but it is the primary moving force of the animal machine, applied in a great variety of ways, and adjusted by the most refined application of the laws of mechanism, to all the degrees and kinds of effects intended to be produced. 'Everywhere,' observes Dr. Roget, 'do we find the wisest adaptation of muscular power to the objects proposed, whether it be exerted in laborious efforts of the limb and trunk; whether employed in balancing the frame, or urging it into quick progression; or whether it be applied to direct the delicate evolutions of the fingers, the rapid movements of the organs of speech, or the more exquisite adjustments of the eye or of the internal ear. Amidst

* Paley's Natural Theology, vol. i. Knight's Edition, pp. 105, 106.

the endless combinations of machinery exhibited in different parts of the animal kingdom, although the mode of application be diversified in ten thousand ways, the original power is still of the same kind, and is regulated by the same physical laws; and similar instruments are employed in effecting this infinite variety of purposes, by the all-wise and omnipotent Architect of Animated Creation."* The mechanical power here applied is the swelling of the belly of the muscle, and the consequent contraction of its tendons. This is easily understood; but what is totally unknown, and will probably continue to be unknown, is the substance or power, whatever it may be, which causes this swelling, whether voluntary or involuntary. It is different from any thing we are acquainted with, and we are unable to construct a machine, by any power of mechanism, which shall be endowed with the same principle. That principle, in short, is not mechanical, though it operates on a very refined piece of mechanism; and we can follow it no farther. But there is no reason arising from our ignorance of this unmechanical principle, which ought to throw any doubt upon the nature of the organization itself, or weaken the proof of intelligent contrivance which it affords. With the very same certainty as if we knew the origin of the motion, we can trace the artificial construction of the muscle for producing the necessary contraction, its skilful position for effecting a particular purpose, and the various combinations and adaptations of such instruments, so wonderfully uniting in a living body to form a perfect whole; and from all this we can derive a proof of design, which no sophistry can gainsay.

From such a mode of reasoning, we may discover both the advantages and disadvantages under which the physiologist labours, when he adduces the animal frame as a proof of Creative Wisdom; and Paley, after illustrating the subject much more at large, and arguing with his usual precision, comes justly to the following conclusions; first, that it is a mistake to suppose, that, in reasoning from the appearances

* Roget's Bridgewater Treatise, vol. i. p. 141.

of nature, the imperfection of our knowledge proportionally affects the certainty of our conclusion, for in many cases it does not affect it at all; secondly, that the different parts of the animal frame may be classed and distributed according to he degree of exactness with which we compare them with works of art; thirdly, that the *mechanical* parts of our frame, or those in which this comparison is most complete, and although constituting, probably, the coarsest portions of nature's workmanship, are the most proper to be alleged as proofs and specimens of design.*

FOURTH WEEK—TUESDAY.

REPRODUCTION AMONG THE LOWER ORDERS OF ANIMALS.

Spring is peculiarly the season of reproduction; and the diversified means by which the various species of animals as well as plants are thus preserved, furnish one of the appropriate subjects of the season, and perhaps the most interesting of all. The same character of similarity in the plan, and difference in the details, which belongs to the rest of the Creator's works, appears strikingly in this. A difference of sexes, which we have seen as one of the features in the reproduction of plants, is exhibited with not less uniformity in all the higher species of animated beings; in which last, however, this difference exists constantly in *distinct* individuals, and never, as frequently takes place among vegetables, in the same individual. But among the lowest orders of the animated creation, this uniformity seems to be departed from, and we have instances of reproduction altogether peculiar and anomalous. According to our plan of beginning at the lowest links of the scale, these shall form the subject of consideration in the present paper.

Fissiparous generation, as it is called, that is, the spontaneous division of the parent into two or more parts, is the

* Natural Theology, Knight's edition, p. 114.

simplest of all the modes of reproduction. Of such a mode, frequent instances occur among infusory animalcules. Many species of globular monads multiply in this way. At a certain period of their development, a slight circular depression appears round the centre of these living balls, which, by degrees, becomes deeper, changing their form to the resemblance of an hour-glass, till at last two globes are formed out of one, attached, like the Siamese Twins, by a single point. These twin existences are now seen swimming irregularly in the fluid which they inhabit, as if animated by two different wills. They struggle to get disunited, and for this purpose laboriously drag each other, first one way and then another, or, by a simultaneous movement, dart through the thickest crowd of the surrounding animalcules. The moment this slender filament is broken, they are observed moving away, without apparent recognition, and each beginning its own independent existence.

These globular animalcules are exceedingly small; and as the infusory tribes increase in size, they take a different shape, many of them being comparatively thick at one end, and tapering to a point at the other, somewhat in the form of a tad-pole. Such of these, as follow the same law of reproduction with the monads we have mentioned, separate from each other lengthwise, forming the division by an incision beginning at the thicker end, and gradually becoming larger and larger, till, after a struggle similar to that of their globular congeners, they finally disunite at the hair-like extremity of the tail. Each animalcule thus formed, soon grows to the size which again determines a further spontaneous subdivision; and thus the same process goes on to an indefinite extent.

'The most singular circumstance attending this mode of multiplication is, that it is impossible to pronounce which of the two new individuals, thus formed out of a single one, should be regarded as the parent, and which as the offspring, for they are both of equal size. Unless, therefore, we consider the separation of the parts of the parent animal to constitute the close of its individual existence, we must recognize

an unbroken continuity in the vitality of the animal, thus transmitted from the original stem, throughout all succeeding generations. This, however, is one of these metaphysical subtleties, for which the subject of reproduction affords abundant scope.'*

In the vegetable kingdom we have no instance of this kind of spontaneous division of an organized being into complete separate existences; but, by artificial means, this mode of reproduction may be effected. Thus, a tree may be divided horizontally into slips, which may continue to grow, and may by-and-by produce a tree similar in all respects to that from which it originated. Even from a small fragment of a plant, under favourable circumstances, a complete plant may be formed, by roots shooting out from the one end, and a stem from the other. These facts show a peculiar species of reproductive power in the vegetable creation under the culture of man, but do not occur in the ordinary course of things.

Of this latter mode of multiplication, we have numerous examples in the lower departments of the animal kingdom. The *Hydra*, or fresh-water polype, is capable of indefinite multiplication by division, although this is not the natural mode of its reproduction. If it be cut asunder transversely, the part containing the head soon supplies itself with a tail, and the detached tail shoots forth a new head, with a new set of tentacula; and if the whole animal be divided into a great number of pieces, each separate fragment acquires, in a short time, all the parts which are wanting to render it an entire individual. The same phenomena are observed, and nearly to the same extent, in the *Plantaria*. The *Asteria*, the *Actinia*, and some of the lower species of *Annelida*, are also capable of being multiplied by artificial divisions—each segment having the power of producing others, and containing within itself a kind of separate vitality.

Something analogous to this, but by no means extending to the capability of reproducing a complete being, exists, in a certain degree, among the higher orders of animals, especial-

* Roget's Bridgewater Treatise, vol. ii. pp. 583—585.

ly in the lower links of the chain. The claws, the feet, the antennæ, and the entire limbs of some of the inferior species of these orders, are restored, when lost, by a fresh growth of the organs. The crab renews its limbs when torn off. If the head of a snail be amputated, the whole of that part of the animal, including its eyes and other organs of sense, will be reproduced. The tails of newts, and of some species of lizards, will grow again, if lost; and even the eyes of these animals, with all their complex apparatus of coats and humours, will, if removed, be replaced by the growth of new eyes. Among the highest class of all, too, similar powers exist, though much restricted. The principle which, in the human frame, closes a wound, repairs a broken bone, or alters the course of the blood when the ordinary channels are closed, is of the same nature, and forms a most beneficent provision.

The less perfect orders of that low class of animated nature called *Zoophytes*, produce the species in a manner analogous to the buds of plants. At the earliest period in which the young of the *Hydra*, for example, is visible, it appears like a small tubercle or bud rising from the surface of the parent. It grows in this situation, and remains attached for a considerable time, at first deriving its nourishment from the parent; then occasionally stretching forth its *tentacula*, and learning the art of catching and swallowing its natural prey. At length the tube through which it received parental nourishment closes, the attaching filaments become more slender and break, and the young hydra moves away, and provides for its own subsistence.*

Another plan of reproduction is that in which the germs are developed in the interior of the animal, assuming, in the first stages of animation, the form of the parent. In the *Volvox*, a spherical revolving animalcule, of the infusory order, this mode is exemplified. The germs of this animal appear,

* There is a species of toad which is said to produce its young nearly in a similar manner, or, at least, similar in appearance. The impregnated germs are conveyed by some occult process to the back, where they grow below the skin like buds, till the period of birth, when they burst forth.

by the aid of the microscope, in great numbers, in its interior, through its transparent covering; and while these are yet retained within the parent's body, other still minuter globules are developed within them, constituting a third generation. This progeny continues to swell till the parent bursts, and thus, in expiring, opens a passage for them to the element where they are in their turn to undergo the same destiny.* In the case of the *Actinia*, the young, or *gemmules*, as such productions are called, force their way through the sides of the body, which readily open to give them passage, and quickly heal; but in most instances of such kind of spontaneous evolution, channels are provided, through which they find their way to a separate existence.

These are some of the extraordinary modes by which the species is continued while the individual perishes, affording us a new and striking proof, that, though the analogies of nature are preserved with remarkable regularity in all the higher species of existences, it is not because the Creator fails in resources and expedients, but because some wise plan of his government has induced him to restrict his creative power, as regards these classes, to certain forms and types, while, in the less complicated organizations, he has found it expedient to take greater latitude. Nothing can be more curious and instructive than the view which the microscope has opened to us, of that busy world of living beings, which lies beyond the sphere of our unassisted vision, so incalculable in their numbers, so diversified in their forms, so opposite from our experience in their modes of propagation, and their means of subsistence; and yet so wonderfully harmonizing, amidst all their vast and anomalous varieties, with the more general analogies with which our senses have made us conversant, as to indicate most unequivocally the contriving mind and plastic hand of One Infinite Intelligence.

* Roget's Bridgewater Treatise, vol. ii. p. 586.

FOURTH WEEK—WEDNESDAY.

REPRODUCTION AMONG THE HIGHER ORDERS OF ANIMALS.

In ascending from the lower and less complicated forms of animal existence to higher orders, we find the mode of reproduction more uniform, or at least more strictly confined to a single type, though still various and peculiar, in different species, with regard to matters of subordinate detail. In all the more perfect animals, reproduction takes place by means of a seed, or ovum, which is a process essentially different in its nature, as well as in the mode of operation, from those already described. In the animal as well as vegetable world, the germ, latent in the seed, is never developed beyond a certain point, unless it be vivified by the action of a peculiar fluid belonging to other organs. The germ, when thus impregnated, receives the name of *embryo*, and the development takes place in one or other of the four following ways:—

1*st*, The ovum, when defended by a firm envelope, which contains a store of nutriment, is termed an *egg*, and is deposited in situations most favourable for the development of the embryo, and also for its future support, when it emerges from the egg. Birds, as is well known, produce eggs which are encased in a calcareous shell, and hatch them by the warmth they communicate, in sitting on them with unwearied constancy. All animals which thus lay eggs are termed *oviparous*.

2*d*, There are a few tribes, such as the *viper* and the *salamander*, whose eggs are never laid, but are hatched in the interior of the parent, so that they bring forth living offspring, although originally contained in eggs. Such animals are said to be *ovo-viviparous*. There are other tribes, again, which, according to circumstances, are either oviparous, or ovo-viviparous. This is the case with the *shark*.

3*d*, *Viviparous* animals, are those in which no egg, properly so called, is completed; but the ovum, after passing through

the oviduct, sends out vessels which form an attachment to the interior of a cavity in the body of the parent, whence it draws nourishment, and therefore has attained a considerable size at the time of its birth.

4*th*, *Marsupial* animals, are those which, like the *kangaroo* and the *opossum*, are provided with abdominal pouches, into which the young, born at a very early age of development, are received, and where they are nourished with milk secreted from glands contained within these pouches. As the young, both in this and the last case, are nourished with milk prepared by similar glands, or *mammæ*, the whole class of viviparous and marsupial animals has received, from this characteristic circumstance, the name of *Mammalia*, that is, animals with *teats*, or milk-vessels.*

The varieties, now mentioned, in the means by which the first processes of reproduction are effected, are neither accidental nor capricious. They are adaptations of remarkable wisdom, connected always with peculiar conditions, either in the state or structure of the organized beings in which they occur. They are parts of a system, which is perfect in its various functions and relations, and admirably suited to fulfil the object in view. We may not always be able to trace the peculiar bearings of this system in all its branches; but, in general, it is open, at least in its great features, to human research; and, even where it is more recondite, there are still circumstances of obvious adjustment, which enable us confidently to say, that here are indications of admirable contrivance and forethought. The simple mode of reproduction, for example, by partition or fissiparous generation, as it is called, or even by buds or germs, produced externally or internally, though well adapted to animals of the infusory tribes, would obviously interfere most essentially with the active functions necessary for the preservation, defence, or enjoyment of animals of a higher grade, and inhabiting another element. We have only to conceive a bird, a quadruped, or a human being, constantly, or even occasionally, undergoing either of the re-

* Roget's Bridgewater Treatise, vol. ii. pp 597, 598.

markable processes by which a monad or a zoophyte multiplies its species, to perceive how unsuitable such a mode would be to their condition; and the more we compare the actual means employed, with the relative situation and circumstances of the different orders, the more reason shall we find to adore the perfections of the Creator. In this general statement, every person, even on the slightest consideration, must find cause to acquiesce; and the more we enter into detail, our admiration will be proportionably increased. It is but a small portion, however, after all, that we can perceive of Creative Intelligence; because our ignorance continually interferes with the researches we make in any direction. All is full of wise adaptation and contrivance, so far as we can trace, and every new discovery of the properties and relations of things, affords us a farther insight into the beautiful designs of an all-pervading Mind; while the farther we penetrate, our convictions become the stronger, that we are yet but at the surface, and that what remains behind, could we but dive still deeper, would only furnish us with more irrefragable evidence of the attributes we love and venerate, in what we actually behold. In prosecuting this pleasing subject, such a view has constantly forced itself on my mind, and I have felt, that, while the operations I described have displayed much of the Divine power, and wisdom, and goodness, I was, after all, only taking an ignorant and superficial survey of a subject of infinite extent,—only looking at the elegant external proportions, and the outward grace of a building, which within was full of a fitness and a grandeur, that, in this mortal state, with my limited faculties and imperfect knowledge, I was not permitted either to approach or to conceive. How delightful is the assurance, that the time will come when, if we belong to that blessed company who inherit the promises of the Gospel, we shall no longer see as 'through a glass darkly.' When that which is perfect is come, and we see 'face to face,' the further discoveries which our enlarged faculties shall be permitted to make, will, as we may well believe, form no mean part of the happiness which Heaven has in store for us.

FOURTH WEEK—THURSDAY.

INSTINCTS CONNECTED WITH THE REPRODUCTION OF ANIMALS.

However curious and instructive the subject of reproduction may be, in relation to its physiological laws and conditions, it is certainly not less so as regards the instinctive propensities and habits, by which these are brought into operation and rendered effectual for the accomplishment of the great object the Creator had obviously in view; and there are few things more wonderful, or more strikingly indicative of wise and harmonious design, than the adaptation of the animal instincts to the physical circumstances of the parent, the embryo, and the offspring. Were there not an exact and intimate correspondence between those two distinct and totally dissimilar things,—the material organization and the living propensity,—reproduction would be impeded not only at every step of its progress, but at its very source, so that the continued existence of any one species of animals would be impossible. To enter into details as to some of these adaptations, would be as inexpedient as it is unnecessary; but the fact, that immediately after the wintry blast which desolated Nature has ceased, and as soon as Spring has begun to scatter a profusion of food over the face of the earth, and to cheer and nourish all things with her balmy breath, the lower animals should choose their mates, and those remarkable instincts should commence their influence, which are to repair the waste occasioned by the law of universal decay, and constantly to replenish the world with living beings, is, in all its circumstances, a phenomenon which, on the most superficial glance, clearly indicates the plan of an Intelligent Creator.

When from this general view we turn to the operation of these instincts in the various races of the animated world, we find with admiration and delight the same uniformity mingled with diversity, which distinguishes the operations of the Creator in other departments of his works, the same adjust-

ment of causes to ends, of instincts to forms, of propensities to propensities, and of one condition to all the rest.

I shall at present take a rapid view of these reproductive instincts, as they appear in the various tribes of animals, with the intention of afterwards filling up the sketch by such details as may serve more fully to illustrate the Divine perfections, exhibited in the means made use of for the preservation of animal life through successive generations.

To begin with the *insect* world; these have all their seasons for fulfilling the great law of Nature, varying according to their peculiar functions and destinies, numerous as these are, to which the organization of each is most admirably adapted, and with which their reproductive propensities are in beautiful unison. It is exceedingly remarkable, as we shall presently see, to observe how each is directed to deposit its eggs where its young, when disclosed, may find their appropriate nutriment. Various circumstances seem to point to the scent,* as the sense by which they are directed to the proper station for their eggs. But whatever there may be in this, the inward propensity is not the less admirable, which conducts by far the most numerous classes of insects, and more especially the whole tribes of the *Lepidoptera*, to seek for a place of deposit for their precious charge, where their larvæ, when developed, may find a species of food suitable for the offspring, but never once used by the parents.

Of vertebrated animals, the lowest classes are cold-blooded, including reptiles and fishes. These seem to have little of that instinctive attention to the welfare of their offspring, which belongs to many of the insect tribes, and is not less remarkably exhibited by numerous families of the warm-blooded animals. They, however, are invariably instructed by the Creator to select a proper situation for their eggs or spawn, where they may be hatched either by artificial heat, or that of the sun. Snakes and other *Ophidians* bury their eggs in sand,

* The flesh-fly, for example, deceived by the smell, frequently lays her eggs on the carrion plant, mistaking it for a piece of decaying flesh, which it greatly resembles in its disagreeable odour.

and not seldom even in heaps of fermenting manure, while the venomous species of serpents are hatched in the womb of the dam. The lizard tribes, from the crocodile downwards, lay their eggs in some well-selected spot, and then leave them to the fostering power of the elements; toads and frogs lay their spawn in the water;—the former, producing two long strings, resembling necklaces, formed, as it were, of beads of jet, enclosed in crystal; while those of the latter consist of irregular masses of similar beads. This gelatinous envelope forms the first nutriment of the embryo. 'The nuptial song of reptiles,' adds Kirby, after giving similar details, 'is not, like that of birds, the delight of every heart; but is rather calculated to disturb and horrify than to still the soul. The hiss of serpents, the croaking of frogs and toads, the moaning of turtles, the bellowing of crocodiles and alligators, form their gamot of discords.'* Here, also, we may read beneficent Design. Birds are the companions of man in the lawn and forest, in his solitary walks, amidst his rural labours, and around the home of his domestic enjoyments. They are, therefore, framed beautiful to the eye, and pleasing to the ear; but of the reptile tribes, some are his formidable enemies, and none were ever intended to be his associates. They shun cultivation, and inhabit unfrequented marshes or gloomy wilds. Their harsh notes, and ungainly or disgusting forms, serve, therefore, to warn him of danger, or to turn his steps to places more fit for his habitation.

With regard to the class of *fishes*, the general object of those that migrate, appears to be the casting of their spawn. It is this that causes the salmon to leave the sea for the rivers; the herring to travel from the profound depths of the north to

* Kirby's Bridgewater Treatise, vol. ii. p. 205. In the first volume, the same author says, 'Travellers describe the noises of crocodiles and alligators as horrible.' 'Crocodiles, during the whole summer,' says Bose, 'but especially after they emerge from the earth, that is, in the spring, and the epoch of their amours, frequently send forth lowings almost as loud as those of an ox. They respond to each other often by hundreds, especially in the evening, which makes in the swampy forest, a frightful and thundering din.'

our native shores; and the mackerel, on the other hand, to pour from the southern regions towards the north; thus, at the same time, by the fiat of their Maker, contributing to their own means of subsistence, and placing themselves in situations where their fellow inhabitants of the ocean may combine with man in preserving the balance of living beings, by thinning their numbers, which their productive powers would otherwise render overwhelming.

If we rise higher in the scale of vertebrated animals, and direct our attention to birds, what a variety of wonderful instincts and habits relating to the propagation of the species meets our view. Some of them, chiefly influenced by this instinct, take long aerial voyages, steering their course over sea and land with a mysterious precision, and arriving, year by year, after traversing vast spaces and crossing many latitudes, at the very same spot where they commenced their own existence, or gave birth to a former progeny; there they rebuild their decayed nests, deposit and hatch their eggs, tend and nourish their callow brood, teach them to use their wings and select their food, and then, when their young powers are fully developed, lead their course through the air, to those distant lands where new and more ample stores are provided for their subsistence by an All-bountiful Hand. Others, though they seek not to migrate, yet display the wonders of that mysterious Power by which they are guided, in the forethought, not their own, by which they are directed with regard to the structure and situation of their nests. One builds upon the surface of the earth; another under ground or in the sand; some select the chimneys or eaves of houses for the place of their structures; some retire to caverns and holes; but the great majority erect their temporary dwelling-places in trees and bushes, with singular arts to elude the pursuits of their enemies.

With regard to quadrupeds, as they escape the long process of incubation, which reproduction by means of eggs imposes on birds, and as their young seldom come into the world helpless, or altogether without the power of locomotion, their pre-

paratory actions are less striking, but are yet most carefully adapted to their circumstances. The dormouse, and various other animals of the same genus, make beds of their own hair, to prepare soft and warm retreats for their young, at the bottom of their holes, to which these, and the other burrowing animals retire, when nature informs them that their hour of travail is come. The domesticated animals, in general, drop their young without any previous preparation,* wherever the pains of labour overtake them; because they procure their own food without care, and in their bodies is contained a delicious and nourishing fluid, which instinct has at once taught them how to offer, and their new dropped offspring how to extract. Beasts of prey, on the other hand, whose progeny come into the world blind, as well as the domestic dog and cat, perform parental duties varied and important, in proportion to the dependence of their offspring on their care. They retire to their dens or lairs, where they tenderly watch over their helpless charge, and, if danger approach, or convenience require, carry them from place to place in their mouths.

All these are instances of an instinct singularly adapted to the situation and wants of the various tribes which are the objects of it; and both in the complication and the simplicity of its movements, evinces a contriving Mind of never-failing resources. The *Storge*, as the ancients were accustomed to name it, or the natural affection of the parent to its offspring, involved in some of these actions, deserves to be considered in a separate paper.

* Lord Kaimes, however, in his 'Gentleman Farmer,' mentions the singular fact, that the female sheep, weeks before yeaning, selects some sheltered spot where she may drop her lamb with most comfort and security; and that, when forcibly prevented from going there, she manifests the utmost uneasiness.

FOURTH WEEK—FRIDAY.

PARENTAL AFFECTION.

In former papers, the attention of the reader has been directed to the wonderful provision, which is made for the preservation of the species of many living beings, which never see their progeny. We have seen, however, that there is another class—and it is a very numerous one—comprehending all the higher orders of animals, the young of which are, for a longer or shorter period, dependant on the fostering care of their elder kindred, which are generally their parents. And in this, as in the former case, the wisdom and benevolence of the Creator are very strikingly displayed; for He providentially inspires the guardians with so strong a desire to discharge their trust with fidelity, that it may well be denominated a passion.

There is, perhaps, no living creature that enters this world in a condition more helpless than man; nor is there any which so tardily attains maturity, in its physical and mental powers. Were the weak and naked infant to be abandoned at its birth, its first breath would soon be succeeded by its last. But it has been ordained that the cries which it emits shall awake in the bosom of the mother, a throe of tender affection, which constrains her irresistibly to devote herself to its nourishment, its protection, and its comfort. In the continued practice of her maternal duties, she experiences a growing and inexpressible delight; and it is mercifully arranged by the Ruler of all, that her affection shall, in general, become more intense, in proportion to the necessity which exists for its exercise. The cripple, the invalid, and the imbecile, are the objects of her peculiar tenderness. That she may minister to their relief and their happiness, she generously abridges her personal indulgences, and her natural portion of rest.

The father participates, to a great degree, in the parental tenderness of his wife; and, if not utterly debased by corrup-

tion, while he fondles and plays with his little ones, his manly heart is softened and improved.

As the young family increases and grows up, its members, if abandoned at so early a stage of their existence, without protection and tuition, would be exposed to inevitable destruction. But their parents are impelled still to watch over them, and, according to their own progress in civilization, to labour with redoubled diligence for their support. If they know what is good, they train them to those arts, and instil in their minds those principles, and that knowledge which may qualify them to gain their living as they approach maturity, to act their part usefully in society, and to enjoy a happy eternity.

The yearnings of parental love are experienced in every stage of civilization. Superstition and wickedness have, no doubt, produced partial exceptions; but these are, by the common voice of humanity, pronounced unnatural; and the parent, when influenced by the unbiassed emotions of his heart, shrinks back with horror at the thought of committing the fruit of his body to the flames or the waves, even for the purpose of appeasing an offended Deity. Nor can any parent hear, without disgust, of famishing women allaying the pangs of hunger with the flesh of their own offspring.*

Too true it is that there are innumerable instances in which ignorant and depraved men train their children to ruin, by example and by precept; yet even these infatuated wretches are rarely devoid of all instinctive partiality for them. Even when occasional anomalies occur, and when the 'father and mother forsake' their offspring, 'then the Lord will take them up,' and supply them with guardians, to fulfil the parental duties. The same providential care is exerted by opening an affectionate interest in the hearts of near relatives, and even of aliens in blood, when the young and helpless are bereft of their natural guardians by death, or by some painful casualty. And it is worthy of remark, that, in such interesting cases, the affection of the substitutes, also, is proportioned to the ne-

* Lamentations iv. 10.

cessities of their dependants. Even a hireling very soon acquires, for the infant she suckles, a love which may be called maternal. The writer of this could specify more than one instance in which nurses have requested liberty to retain and rear, at their own expense, the children of aliens committed to their charge by the parochial authorities.

Nor is the influence of this law confined to the human race. It extends to all species of animals, not excepting insects, which enter into the world in a state that finds them incapable of catering for their own support. Even the ferocious tiger, and the ravenous vulture, unequivocally manifest the yearnings of strong affection for their young. The mother always, and, in the case of pairing animals, the father frequently, furnish the food, and warmth, and protection, which are required, with the most disinterested sacrifices of personal rest and comfort. Reference has, in the preceding paper, been made to some creatures, which denude themselves of their natural clothing, to secure their offspring from cold, during the more helpless stage of their existence; and the anxiety with which they minister to the wants of their dependants, must excite the admiration of the most casual observer. To take a very familiar instance: Look at that domestic hen, with her little brood of chickens, and see how vigilantly she watches over them, searching out the food convenient for them, where it lies hidden under the rubbish, and, with generous self-denial, restraining her own appetite, that she may relieve their craving wants. See how she bristles up at the approach of a suspected stranger, and what a bold demonstration she makes of courage, which is foreign to her nature when she has no family to defend. Observe how anxiously she recalls her chickens when they heedlessly stray into paths of danger, and with what kind complacency she hides them amongst her feathers. She thus communicates to them, from her own body, that warmth which, in their unfledged state, is necessary for their comfort and vitality.*

* The writer remembers having once watched, with much interest, the proceedings of a barn-door hen, which, in the exercise of her maternal af-

None need be reminded of the occasion on which our Divine Redeemer referred to this affectionate habit of the domestic fowl, in illustration of his tender and disinterested love to the inhabitants of a murderous and ungrateful city.

The most timid mothers brave dangers, and even death, for the sake of their young. An instance of this courage—and similar facts must be familiar to many—is recorded by Colonel Montagu, when speaking of the gold-crested wren. 'A pair of these birds, who took possession of a fir-tree in my garden, ceased their notes as soon as the young were hatched; and as this beautiful little family caused me much delight and amusement, some observations thereon may not be unacceptable to the curious reader. When first I discovered the nest, I thought it a favourable opportunity to become acquainted with some of the manners of this minute species, and to endeavour to discover whether the male ever sung, by way of instructing the young ones. Accordingly I took the nest, when the young were about six days old, placed it in a small basket, and, by degrees, enticed the old ones to my study window; and after they became familiar with that situation, the basket was placed within the window, then at the opposite side of the room. It is remarkable that, although the female seemed regardless of danger, from her affection to her young, the male never once ventured within the room;

fection, laboured long, but ineffectually, to convey her brood across a shallow stream, on the opposite border of which she had discovered a treasure for their use. The timid chickens durst not enter the water; but, at last, the mother contrived to make them mount upon her back, and so to carry them over. This is an additional illustration of some remarks made in the first volume of this work. *Winter*, Fourth Edition, pp. 187, 235. To the same class of facts may be referred the following, which occurred many years ago at a farm-house in Galloway. The family were one evening alarmed by loud screams, accompanied by the flapping of wings, and, it is added, a knocking at the door, when, on going to ascertain the cause, a gander was discovered in a state of the utmost agitation. The creature led the way to the goose-house, evidently inviting the servants to follow. On entering, a polecat rushed out, and on a nest, with young goslings below her, lay a slaughtered goose, which had evidently refused to seek her own safety by sacrificing her young.

and yet would constantly feed them while they remained at the outside of the window; on the contrary, the female would feed them at the table at which I sat, and even when I held the nest in my hand, provided I remained motionless. But on moving my head one day while she was on the edge of the nest, which I held in my hand, she made a precipitate retreat, mistook the open part of the window, knocked herself against the glass, and lay breathless on the floor for some time. It it probable the focal distance of such minute animals' eyes is very near, and that large objects are not represented perfect on the *retina;* that they do not seem to see such distinctly is certain, unless in motion. However, recovering a little, she made her escape, and in about an hour after, I was agreeably surprised by her return; and she would afterwards frequently feed the young, while I held the nest in my hand. The male bird constantly attended the female in her flight to and fro, but never ventured beyond the window-frame; nor did he latterly ever appear with food in his bill.'

Even the earwig and the spider, which some regard as odious creatures, are inspired by the great Governor of all with this amiable disposition in a remarkable degree. The wolf-spider carries her eggs in a bag attached to the hinder part of her body, and guards this treasure with jealous care. 'With a view,' says Bonnet, 'to put this singular attachment to a novel test, I one day threw a spider with her eggs into the pit-fall of an ant-lion (*Myrmelion formicarium*). The spider endeavoured to escape, and was eagerly remounting the side of the pit, when I again tumbled her to the bottom, and the ant-lion, more nimble than the first time, seized the bag of eggs with its mandibles, and attempted to drag it under the sand. The spider, on the other hand, made the most strenuous efforts to keep her hold, and struggled hard to defeat the aim of the concealed depredator; but the gum which fastened her bag, not being calculated to withstand such violence, at length gave way, and the ant-lion was about to carry off the prize in triumph. The spider, however, instantly re-

gained it with her mandibles, and redoubled her endeavours to snatch the bag from her enemy; but her efforts were vain, for the ant-lion being the stronger, succeeded in dragging it under the sand. The unfortunate mother, now robbed of her eggs, might at least have saved her own life, as she could easily have escaped out of the pit-fall; but, wonderful to tell, she chose rather to be buried alive along with her eggs. As the sand concealed from my view what was passing below, I laid hold of the spider, leaving the bag in the power of the ant-lion. But the affectionate mother, deprived of her bag, would not quit the spot where she had lost them, though I repeatedly pushed her with a twig. Life itself seemed to have become a burden to her, since all her hopes and pleasures were gone for ever.'*

Even among the inferior animals, the substitution of nurses different from the parents sometimes occurs; and, in such cases, the law continues in force, which elicts, in the guardian, a love for the proteges, akin to parental affection. This is well exemplified in the attendance which the foster-mother of the cuckoo so assiduously bestows on her overgrown charge, and may be seen in every farm-yard, where ducklings have been hatched under a hen, or chickens under a capon.† The unwearied care with which the larvæ of bees, wasps, and ants, are tended by barren nurses, has called forth the admiration of all who have minutely observed the domestic economy of these curious insects. Man may well learn wisdom by considering the ways of creatures which are destitute of reason; for they are guided by a wisdom infinitely

* Bonnet, Ouvres, vol. ii. p. 435.

† The writer can vouch for the following fact:—A barn-door fowl having been deprived, by some accident, of all her brood but one, resigned the survivor to the care of the cock, while she reconstructed her nest, and resumed the occupation of replenishing it with eggs. The cock entered into this arrangement with the utmost cordiality, and discharged his duties as a father with much zeal and love, courageously repelling every enemy, searching out barley-corns with the utmost diligence, giving the usual notice to his little follower, and feeding it with the characteristic generosity of his fraternity.

superior to his. They are irresistibly impelled, by an invisible power, to adopt means for promoting the best interests of their young. Man, too, is inclined by the same power to love his children; but he has sinful propensities within, which often lead that love into a ruinous direction.

'Let us hear the conclusion of the whole matter.' God is the *Parent of all;* and he uses natural affection to make his substitutes,—earthly parents of various species,—faithful to their trust. 'They are but the wheels and instruments,' says Burmeister, 'in a higher Hand, imperceptible to us and still more so to them, which holds the universe, and to which science must always refer, but which is depicted to the fancy in a beautiful and attractive image. What Johan Von Muller has expressed to be the result of his researches into the history of the human race, we may apply to the life of bees, to the actions of the rest of the world of insects, and indeed to the great efforts of organic nature in general. The whole is an infinite machine, to whose eternal motion every individual, be it plant, animal, or man, must contribute; and he who of all that can obey this law, is wantonly deaf,—he is judged.'* T. T. D.

FOURTH WEEK—SATURDAY.

REPRODUCTION OF INSECTS.—THEIR EGGS.

I HAVE already taken some notice of the eggs of insects, in reference to the qualities with which they are endowed for resisting the rigours of winter.† It may now be proper to say a few words regarding their general properties and peculiarities, as well as the instincts belonging to the female, which secure their deposition in the most proper situations.

It has been remarked by some naturalists, that the eggs of

* Manual of Entomology, p. 531.

† 'Winter,' Fourth Edition, p. 191, &c.

insects, which are of very various shapes and colours, have, at least in many instances, expansible shells, which enable them to increase in size, according to the progressive development of the enclosed larva. The younger Huber discovered this quality in the eggs of ants, and others have observed the same gradual enlargement, along with change of shape, in those of other insects. The design of the Creator in this expansible property, is sufficiently obvious, and there are some natural contrivances in certain eggs, the final cause of which we can also distinctly trace. The eggs of the ephemeræ, for example, are smooth and oblong, resembling carraway comfits, a form, which Swammerdam mentions, as admirably adapted for diffusing them through the water, where they are dropt by the mother insect. To prove this, he placed a few of them on the point of a knife, and letting them fall gently into the water, they immediately separated of themselves, in a very curious manner.* The same accurate observer describes a very remarkable appendage in the egg of the water scorpion. This egg is furnished with a coronet of seven bristles, disposed like down on the seed of the blessed-thistle. These bristles closely embrace the egg next to them in the ovary of the mother insect. As these eggs are deposited in the stems of aquatic plants, the bristles, which are partly left on the outside, are probably intended to prevent the aperture from being closed by the rapid growth of the plant. Reaumur gives an interesting description of similar eggs, deposited by a common dung fly. These eggs are furnished at the upper end with two diverging pegs, which prevent them from sinking into the dung, where they are placed by the parent, while they are permitted to enter sufficiently far to preserve them moist. Both circumstances are indispensable to their hatching; for when Reaumur took them out of the dung, they shrivelled up in a few hours, and when he immersed them farther than the pegs, they were suffocated, and could not afterwards be hatched.†

* Book of Nature, vol. i. p. 204. † Reaumur, Mem. iv. p. 37.

A still more remarkable appendage belonging to some insects' eggs, is that of a foot-stalk, evidently intended to place them out of the reach of grubs, which might devour them. The eggs of the lace-winged fly are of this description. They consist of a small oval greenish white head, similar to apple mould, with a white transparent stem, more than an inch high, and not thicker than a human hair, but smaller, and more stiff and rigid. About a dozen of these eggs are deposited by the fly in a single, and sometimes in a double, line, upon the leaves or branches of the elder, and of other trees and plants, abounding with aphides, upon which the grubs feed when hatched. The foot-stalks of these eggs are formed by the mother fly attaching a drop of gluten to the branch, and drawing it out to the requisite length, before the egg is deposited on its summit. As she uses her body for a measure, the foot-stalks are all of one length. They are so smooth and slender, that the grubs could not climb upon them.

Many eggs are immersed in a glutinous liquor, by which they are made to adhere to trees, or other substances, where they are deposited, or united together in various forms, and for various purposes of safety. In the 'Winter' volume, I noticed the remarkable instance of the gipsy moth, which, by means of this gluten, not only fixes her eggs to the tree and to each other, but covers them over with down taken from her own body, to preserve them from the inclemency of the weather. A still more admirable use of this glutinous fluid is made by the common gnat, which is too curious to be passed over. It is described by Reaumur, who, by repairing to a pond, or bucket of standing water before five, or at latest, six in the morning, frequently witnessed the remarkable operation; and it has also been seen and described by other naturalists.

The problem of the gnat is to construct a boat-shaped raft which shall float, of eggs heavy enough to sink in water, if dropped into it one by one. The eggs are nearly of the pyramidal form of a pocket gunpowder-flask, rather pointed at the upper, and broad at the under end, with a projection

like the mouth of a bottle. The first operarion of the mother-gnat is to fix herself by the fore-legs (four in number) to the edge of the pond, or on a floating leaf, with her body level with, and resting upon, the surface of the water, excepting the last ring of the tail, which is a little raised. She then crosses her two hind legs in the form of an X, the inner opening of which is intended to form the scaffolding of her structure. She accordingly brings the inner angle of her crossed legs close to the raised part of her body, and places in it an egg covered with gluten. On each side of this egg she places another, all which adhere firmly together by means of their glue, and form a triangular figure, which is the stern of the raft. She proceeds in the same manner, to add egg after egg, in a vertical (not horizontal) position, carefully regulating the shape by her crossed legs. As her boat increases in magnitude, she pushes the whole gradually to a greater distance, and when she is about half finished, she uncrosses her legs and places them parallel, the angle being no longer necessary for giving the proper shape. Each raft consists of from 250 to 350 eggs, which, when all laid, float on the water secure from sinking, and are finally abandoned by the mother. They are hatched in a few days, the grubs issuing from the lower end; but the boat, now composed of the empty shells, continues to float till it is destroyed by the weather.* Kirby describes this little vessel as resembling a London wherry, being sharp and high, as sailors say, fore and aft, convex below, and concave above, and always floating on its keel. 'The most violent agitation of the water,' he adds, 'cannot sink it, and what is more extraordinary, and a property still a desideratum in our life-boats, though hollow, it never becomes filled with water, even when exposed.'

The sequel of this remarkable mode of reproduction is not less curious. The larvæ, when hatched, drop to the bottom of the water, and are there transformed into pupæ. About eight or ten days after this transformation, the pupa prepares, generally about noon, for emerging into the air, raising itself

* Reaumur, Mem. iv. p. 621.

up to the surface, so as to elevate its shoulders just above the level of the water. It has scarcely got into this position for an instant, when, by swelling the part of its body above the water, the skin cracks between the two breathing tubes, and immediately the head of the gnat makes its appearance through the rent. The shoulders instantly follow, enlarging the breach. The most important, and indeed indispensable, part of the process, is the maintaining of its upright position, so as not to get wetted, which would spoil its wings, and prevent it from flying. Its chief support is the envelope which it is throwing off, and which now serves it as a life-boat, till it gets its limbs set at liberty and trimmed for flight. The body of the insect serves this little boat for a mast. When it has extricated itself all but the tail, it first stretches out its two fore-legs, and then the middle pair, bending them down to feel for the water, upon which it is able to walk as upon dry land,—the only aquatic faculty which it retains after having winged its way above the element where it spent the first stages of its existence.*

This is but one instance, though a very striking one, selected out of cases almost innumerable, in which astonishing and unexpected means are made use of for the preservation of animals, and especially of insects, in their earliest state. In contemplating such cases, imagination seems scarcely to keep pace with the reality. Here is a creature, committed, in its embryo form, to the surface of the water, in a life-boat constructed and launched by a parent to whom submersion is death; sinking, when developed, to the bottom of these waters, to which its life is fitted, where alone, indeed, it can live, and where it passes from one stage of existence to another; then, at the appointed time, rearing its head above its watery habitation,—becoming all at once an inhabitant of another element, spurning both the water and the land, and floating aloft on transparent wings in the balmy air. The transformation of insects, itself a miracle, is familiar to us; but the circumstances attending the changes of this little gnat,

* Insect Transformations, pp. 317, 318.

seem to have been contrived for the express purpose of exhibiting, in peculiarly interesting and remarkable combinations, the various properties of Creative skill, contrivance, adaptation, and forethought. So that, were there no other proof of these attributes in the universe, it would be impossible to mistake them here, or to withhold from the Creator the tribute of admiration.

FIFTH WEEK—SUNDAY.

ON THE UNIFORMITY OR SAMENESS IN THE NATURAL AND MORAL WORLD.

Alter et idem may with fitness be inscribed on every thing in creation. The living spectators are shifted, the spectacle continues the same. 'The sun ariseth, and goeth down, and hasteneth to his place whence he came.' His rays fall for the first time on the eye of infancy, and for the last on those of age; but they warm the bosom of the same earth, illumine the same mountains, and gild, as yesterday, the same firmament of clouds. 'The wind goeth toward the south, and turneth about unto the north, it whirleth about continually.' It propelled the rich argosies of Venice over the blue waves of the Ægean, and wafted on its course the timid bark that crept along the Grecian shore—just as to-day it swells the sails of the deeply laden and adventurous Indiaman, and carries to his station the messenger, whose purpose it is to publish the story of peace to the heathen. It is the same breeze that plays in the branches of the oak to-day, which waved them in the sight of our forefathers. The tree, the air, the light are the same, but the eyes are changed. Yet it is probable that the contemplation or enjoyment with which they are observed is very similar.

Change is an indication and sure companion of imperfection. With the great Author of the world there is no change.

The laws of instinct continue to descend through growing ages unaltered. The seasons, circling in harmonious round, continue in unalterable succession. But that which is unvarying to centuries, is new to man—and what is uniformity with God, with us is vicissitude. Length of days, experience, and contemplation are requisite to unfold to us that there is nothing new in all the events and feelings of which we are the subjects. The succession of generations, has been but a renewing of the emotions and experiences of the generations that are passed; 'the thing which hath been, it is that which shall be; and that which is done is that which shall be done, and there is nothing new under the sun.'

There is something subduing and tranquillizing in this view of things. Would we madden ourselves with the wild follies of youth, and give a loose to the most unreflecting levity, there have been thousands of hearts as vain and light as ours, glorying in juvenile strength, and rioting in unbridled merriment—but where are they now? Would the sterner powers of manhood prompt us to do and to dare bravely, to achieve reputation at the expense of unceasing exertion, and unrelaxing energy—the brave, the wise, the energetic, have tried it all before us. No steep that we would climb lies yet untrodden. Each bears the trace of many a resolute foot-mark, and many a hard conflict—but they who traced them, where are they now? Does disappointed hope press us to the earth;—has sudden grief driven us to all the extremity of woman's anguish; have we beat the breast, torn the hair, and tossed up the helpless hands in desperation:—Think you that your breast alone has been so beaten, your hair alone so torn? Ah, no! Whatever has been experienced by you, has been the portion of a thousand others. They too have wept, have groaned, have refused *ever* to be comforted; and where are they?

'He grieved—but now his griefs are o'er;
He joyed—but his delights are fled;
Had friends—his friends are now no more;
Had foes—his foes are dead.'

Not the wind only, but the times and tides of man 'whirl about continually, and return again according to their circuit.' Is thy case perplexing? Depend upon it, it is not new. Is thy woe profound? Trust me, there has been deeper. Is thy condition hopeless? Oh, say not so! It hath an end; and thou shalt change, and look back with wonder on the soaring of thy delights, and the profundity of thy despairs—and yet thou shalt be conscious that thou art the same, and never, in any change, losest thy identity. Thou shalt be sensible that the whole system of thy hopes, and fears, and cares, are altered, and yet that thou art the same being that experienced them once, and experiences them no longer. There is something within thee that forms *thyself*, and *thyself* alone; and no event can deceive thee, or beguile thee into the belief that thou art another. Adam, the world's great patriarch, endowed with strength, without the consciousness that it could fall into weariness; with sight, that gazed upon the sun unquailing; with mind, that grasped and admired the wonders of creation; with soul, that communed with the Holy One, and trembled not, but rejoiced—Adam, poor Adam! the outcast, the toil-worn, the defenceless, the weeping father of bleeding Abel, the soul-stricken father of vengeful Cain, still failed not to recognise himself—to feel his miserable identity clinging to him—to own in his bleeding heart's core, that he *was* the man—that he *is* the man. And Adam, the subdued, the reduced to obedience, the atoned-for, the reconciled, though restored to the power of prayer, consoled, renewed in the spirit of his mind, conscious of another nature sprung up and growing within him—still would look back to what no other man could contemplate, and through the three solemn changes, each of which seems enough to extinguish identity, would feel that he was, and had ever been, the same.

Mysterious consciousness! hidden in thy springs, but efficacious in thy influence—like the power of conscience, clinging and cleaving still unsought, unbidden, undesired by us, but ever present, ever influential!—the God who gave our being, gave us thee; and thou, a deathless principle, will ad-

here to us for ever. The grave will hide the hand that holds the pen; the worm will consume for its necessities the frame which now walketh upright on the earth; its ashes may be dissipated or scattered; but the spirit that once inhabited that tabernacle, hath entered its place of waiting, naked, but not unmindful of its former dwelling; lingering till its reunion be completed, and perfectly aware of that which was its own. O! solemn hour of reunion, when those who are in their graves shall hear—those who have been deaf and dead for centuries shall awake to the voice of the last trumpet, and, rising, find themselves again tenanted by the ancient partner, the companion, it may be, of many offences, many woes, many unbeliefs, many reasonings, many conflicts. There will be there no mistake. No ransomed dust will be made the dwelling-place of an impenitent spirit. No frame unrenewed shall be able to take for its partner in hatred a soul that has been sanctified. He who said and it was done, who commanded and it stood fast, will restore all things to order and beauty, and gather into the mansion prepared by the gracious Forerunner, every renewed one rejoicing in its conscious identity, and blessing and praising Him who hath made it another, and yet left it the *same*.

Reader, hast thou ever contemplated the certainty of this consummation of all things? Hast thou thought what may be thy position, when thy mortal is putting on its immortality, when thy now corruptible and perishing frame shall be assuming incorruptibility? How may it be with thee then? Is it not possible that thy spirit, restored to its ancient tenement, may howl around it, and long to make its escape? Would not Dives rejoice to exchange his being with Lazarus, even at the price of being extended at his own gate, subject to the mercies of the dogs? May it not be, that those who may have been the objects of thy contempt or derision, are now 'comforted,' and thou 'tormented?' Wouldst thou change places with the humblest and most despised of the company of the redeemed? Think of it now, thou canst not. Thy identity, thy terrible identity, will adhere to thee, like the poisoned

shirt to Hercules. The soul that rebelled must die, the members that sinned must suffer. They must be reunited in a union of woe. Thou canst neither escape from, nor lighten the anguish. Thou art the same; thou didst choose to be the same; and thou must continue the same through eternity.

Shall the rivers return again to the ocean whence they came, shall the wind veer about till it recover its former position, shall all things exhibit a tendency to approximation towards that from whence they sprung, and shalt thou remain unchanged? Wilt thou not hasten to become *another*, and yet the same? Thou hast sprung from God, thou wert made for God, thou hast been ransomed by God.—Wilt thou not return to God? Rest not till the enigma is interpreted, how thou canst retain thine identity, yet change thy passions, thy hopes, thy very destination. And when thou shalt witness the new buds on the ancient trees, and the fresh verdure springing from the seemingly withered herbage, go and learn what is meant by bringing forth fruit to His glory, whom hitherto thou mayest not have glorified, and by delighting in His service, whom in time past thou mayest not have served.

M. G. L. D.

FIFTH WEEK—MONDAY.

REPRODUCTION OF INSECTS—CARE OF THEIR OFFSPRING, EXEMPLIFIED IN BEES AND WASPS.

In the volume on 'Winter,' I particularized, among the *hybernating* instincts of other insects, those of the *bee;* and in turning to the reproductive instincts of this order of the animal creation, the bee seems still to claim our peculiar notice. It is true that spring is not the season in which the bee, any more than numerous other tribes of the same genus, exercises, to any great extent, its reproductive powers, though it is in this season that it makes the first great preparations for the

fulfilment of that important function; and, were I to follow rigidly the precise order of time, I might perhaps be induced, either to postpone the whole subject, as connected with this wonderful insect, to the summer division of my labours, or at least to confine myself to the consideration of its building instinct. But it seems more convenient to connect together the various phenomena of reproduction, as exhibited in the different orders of living beings, without strict reference to the arrangement of time; and, therefore, I shall now treat of such of the habits and functions of this interesting little animal, as relate to the propagation of the species.

Referring to the sketch contained in the 'Winter' volume, of the instincts belonging to the four different *castes* which inhabit a hive of the common working bees, I begin by noticing the preparations which are made for the future progeny; and this necessarily includes some account of the construction of their cells. As soon as a swarm of bees enters a new hive, they begin to make cradles for the residence of the expected offspring, as well as storehouses for the hoarding of their food. These are, in fact, the same little chambers, or at least chambers on a precisely similar construction. They are composed of wax,—a substance which was long believed to be extracted from flowers, but has now been ascertained, beyond all doubt, to be a secretion exuded through the openings of the rings formed by the scales of their bodies. Their mode of operation, which is sufficiently curious, is said to be as follows:—They commence by clustering, as it is called, which is effected by two bees taking hold of the roof of the hive, at a certain distance from each other, and others clinging to their legs, and to each other's, so as to form long rows, like garlands or strings of beads. Many such strings form a cluster. In this way they remain for twenty-four hours, almost without motion, and meanwhile the necessary secretion has been going on, and by-and-by the wax may be seen at the edge of the rings, which then appear bordered with white. 'At last a bee comes out from the crowd, clears about an inch, by driving away the others with his head, and, settling in the

middle of this space, begins to lay the foundation of a comb, which is a flat piece of wax, composed of a great number of cells. These cells are joined to each other's sides, and placed in a double row, end to end, so that each side of the comb is full of holes, fit for containing eggs or honey. The bee, we have just mentioned, pulls out the little cakes one by one from its wax pockets, holds them in a pair of pincers, with which its legs are furnished, and works them about with its tongue, which is as useful as a trowel. When these are fixed to the roof of the hive, it disappears among its companions. Other bees follow this example, adding their little store of wax, until a lump is formed large enough to work upon. The cells are then formed by another set of labourers; and a third party finish and polish the work, by drawing their mouths, their feet, and their whole bodies over it, again and again, until it is quite smooth.'*

While many labourers are thus employed, others are industriously engaged in collecting food, which, after satisfying their own appetite, they bring to those that are working at the cells, that they may not be interrupted. When the labourer is hungry, he bends down his trunk before the bee that is to feed him, which pours a few particles of honey into it, and, thus satisfied, he proceeds with his task.

The hexagonal form of the cells has been deservedly admired, as a remarkable instance of instinctive wisdom,—a wisdom not belonging to the bee, but to Him who created it. It may be demonstrated to be the best possible shape, for consuming the least wax, and filling the smallest space.—The manner, too, in which the cells are constructed, the sides of one cell forming the centre of the bottom of the opposite, is a most skilful contrivance for strengthening the whole structure of the comb, which ought not to escape observation. Neither

* 'Insects and their Habitations.'—This pleasing little book for children contains distinct and accurate descriptions, of which, when they have answered my purpose, I have freely availed myself, as the information is drawn from the best sources, and the work, humble as are its pretensions, is exceedingly interesting and useful.

should it be forgotten, that, although the range of the comb is perpendicular, that of the cells is not precisely horizontal, as it would be, were they placed at right angles to its plane; they are uniformly sloped slightly upwards, to such an extent as, when assisted by the pressure of the external air, prevents the liquid from flowing out.

When these preparations are sufficiently advanced, and the season is favourable, the queen-bee, which is the mother of the whole progeny belonging to the colony, having hitherto superintended the entire operations, and, by her presence, given vigour and animation to them all, without, however, taking part in the work herself, commences her peculiar functions. In a single aerial excursion, having found a husband for herself in one of the drones, she begins to lay her eggs, which she deposits, one by one, in the cells, by the insertion of the hinder part of her body. In a day or two, a little worm is hatched from each egg, the heat of the hive, kept up by a numerous swarm, being sufficient for that purpose. This little maggot is at first rolled up, at the bottom of the cell, in the form of a ring; and, as soon as it is so far advanced as to require food, this is carefully supplied by the *nursing* bees, from stores of bee-bread, previously prepared from the *pollen* of flowers by the forethought, or rather by the remarkable instinct, of the particular class to which this office belongs. In about ten days, the worm is full grown, and its attentive nurses, knowing that it will require no more food, seal up its cell with wax. It then spins for itself, like the caterpillar, a soft web, and is changed into a *chrysalis*. In this state it undergoes its final transformation, and, after about ten days of sleep, breaks open the seal, assisted by the nurses, and comes forth a perfect bee. No sooner has it come to the surface of the comb, than it cleans itself with its legs, and then immediately unites with the rest of the swarm in the active duties of its caste.

As soon as the young bee is freed from its cradle, the queen, without waiting to clear away the silken swaddling band with which it was enveloped, supplies the place with

another egg. Thus the breeding-comb is kept full; and it is said that a single queen sometimes produces no fewer than sixty or seventy thousand young bees in one year. Of course, a hive of an ordinary size cannot possibly contain so numerous a progeny, and colonies are sent off; or, otherwise, contrivances, such as I have mentioned in the 'Winter' volume, are resorted to, to prevent the *casting*, as it is called, and to induce the supernumerary population to settle quietly down by the side of the parent stock.

Besides the domestic bee, whose instincts and habits are so well calculated to raise the mind to the contemplation of that Divine Intelligence, from whom it so obviously derives the whole mysterious impulse by which its actions are regulated, there are several other families of the same species, which differ from it, not only in their appearance, but in their modes of operation.

Of these, I shall first notice the *carpenter bee*, a solitary worker, one of the most remarkable of which, distinguished by beautiful wings, of a deep violet colour, is not found in this country. With her two strong teeth, she chisels out a hole in some decayed wooden post, to the depth of twelve or fourteen inches, making it as smooth and neat as if she had used the tools of the tradesman whose name she bears. Here she places her eggs, at intervals, in the following remarkable manner:—Having deposited an egg, along with such quantity of pollen as it will require in its state of a grub, she forms a compact covering for it, by gluing together, with her wax, pieces of the dust she had formed in boring. These she most ingeniously, and with great industry, unites to each other, till she has completed a partition, about the thickness of a half-penny. This partition, which closes up the first-laid egg, forms a solid bottom, on which she deposits another, with an additional quantity of pollen; and so on, cell after cell, one above another, till, in the course of some weeks of hard labour, she has filled up the whole tube, carefully stopping up the entrance at last, to prevent the intrusion of enemies.

But this is not all. The little workman, as if foreseeing

that the eggs which were first laid would be first hatched, and that, unless some provision were made for the escape of the elder bees, they would be kept prisoners till those which were younger by several days had come to maturity, and had made their escape, does not consider her maternal task completed, till she has bored a hole at the bottom of the tube, to the open air, by which they may effect their deliverance, one by one, according to their ages, each having only to gnaw through its own cell, into those left open by the bees which have already disengaged themselves. Another remarkable circumstance is, that, in turning into a chrysalis, each grub places itself with its head downwards, as if conscious of the way prepared for it to make its escape.

The wasp, another solitary labourer of this wonderful class, has no power of exuding wax from her body; but she is led, by her natural instinct, to supply this want in a very remarkable manner. By masticating the fibres of wood, and moistening them with a gummy liquid, which her mouth supplies, she kneads them into a kind of paste. With this she lines the roof, sides, and bottom of a cell, which, if she has not been fortunate enough to find ready formed, she has excavated for herself in the earth, to the extent of about a foot square, or sometimes considerably more. The paste is spread, by means of her tongue and feet, into very thin layers, with spaces between, of which she employs fifteen or sixteen, as an envelope, to secure her habitation from damp and external injury, thus making the walls about two inches thick. She then forms her combs of the same material, across the interior like a hanging floor, supporting them with rods, of about an inch long, fixed to the roof. The cells are as neatly shaped as those of a bee-hive; and nothing can be more wonderful, than that one unaided and feeble insect should be able to perform so much, and with such singular art; and all, too, for the accomplishment of a future object, of which she cannot be believed to form any idea—the propagation of the species. Could it be supposed, that she was influenced by imitation and experience, the mystery would not be solved;

because the question would still recur, Whence did the first wasp derive her skill, and how did she impart it to her progeny? But, in the present instance, even this modification of the wonder is entirely excluded; for it has been ascertained, that a wasp survives only one summer, and a female of this class can, therefore, never have seen the duties of a mother performed by her own parent. They lay up no winter provision, and the species is preserved by a very few of the youngest and strongest out-living the privations of the cold season in a torpid state, while all the rest, amounting to thirty or forty thousand in a swarm, perish in their nest.

When the queen-wasp has finished a few cells, and laid her eggs in them, she intermits her building labours, to collect food for the young grubs, which will soon be hatched. In a few weeks these become perfect wasps, and work with the parents in making new cells for the future brood, and in the duties of feeding and nursing the young. By the end of summer, there are, on an average, not fewer than from fifteen to sixteen thousand cells; and, as several wasps are produced in succession from a single cell, it has been calculated, that one female may produce a progeny of above three hundred thousand!

When we remember, that the astonishing labours we have been describing, belong but to one class of instincts impressed on a single order of tiny and feeble insects, in whose history, and in the history of whose whole genus, every thing is surpassingly wonderful, we feel that language has no words to express the admiration with which our hearts are filled. Let the contemplation exalt our views of the infinite and ever-glorious perfections of the Creator. Every where his hand is visible; but it appears to me, that he never lays it more bare to the view of mortals, than in the instinctive propensities with which he guides the irrational world of living beings to fulfil his high behests.

FIFTH WEEK—TUESDAY.

REPRODUCTION OF INSECTS.—THE MOTH—THE BURYING-BEETLE —THE ANT.

This paper shall be devoted to a detail of some other instances of peculiar instincts among the insect tribes, relating to the propagation of the species.

The previous observations on bees lead me to notice an insect, which seems intended by Providence to preserve the balance of living beings, by carrying destruction into the colonies of these industrious creatures—an application of a principle which we have already observed to be established as a universal law of Nature, relating to organized existences.

Bees, like other animals, have many enemies, which prey upon themselves, or their stores. Among these, perhaps, there are none more formidable than various kinds of moths. Night is the time when the latter fly about, and, as bees do not see distinctly, except in a strong light, the moths frequently elude their vigilance, gliding in between the guards stationed at the mouth of the hive, which these creatures take special care not to disturb. If, however, the approach of the enemy is discovered, the daring attempt proves fatal; for the watchers immediately utter a loud hum of alarm, which brings many to their assistance, armed with their deadly stings, and the intruder is despatched without mercy. When, however, the wily moth succeeds in gaining admittance, she then, by the rapidity of her motions, generally escapes her pursuers, even when some of the watching bees become aware of her intrusion. Having accomplished this, and ensconced herself in a secure corner of the hive, she lays her eggs, which was the only object that induced her to incur the danger; for neither the bees, nor any part of their stores, can afford the means of subsistence to herself, although the wax is the proper food of the young grubs, which are to proceed from the eggs. As soon as they are hatched, each grub forms a wind-

ing tube in the wax, sometimes eighteen inches long. These tubes are lined with silk, which the bees are unable to pierce, and thus the grubs remain secure amidst the poisoned weapons of their enemies. They bore through the wax in every direction—no part is safe from their ravages, and the bees are frequently compelled to yield all the fruits of their industry to these formidable spoilers, and to leave them in entire possession of the hive.

I shall next advert to the extraordinary habits of another insect, of a nature altogether different from those already mentioned, but not less strikingly indicative of beneficent intention in the Creator, who formed its frame, and inspired its propensities: I allude to the burying-beetle.

It may seem strange to those who reflect on the mortality which takes place among all the races of animated nature, that so few dead bodies meet our sight in our rural walks, and so few of those nauseous and pestilential smells, which arise from animal substances in a state of decay, assail our olfactory nerves. One obvious and very extensive cause of this is, doubtless, that natural law by which one animal is made to prey upon the dead carcass of another, or to seize and devour it while yet alive; and the evil consequences which might ensue, were animals endowed with no such propensities, have been frequently and successfully urged as one argument, though by no means the strongest, in defence of a providential arrangement, which, on a cursory view, may appear to militate against the Creator's attributes of benevolence. But the Author of Nature has provided other means, also, by which noxious or disgusting objects are removed from the earth's surface. There are some species of insects, and of animals both of a higher and lower grade than insects, which have been appropriately called Nature's *scavengers*. Of these, one very remarkable family is that whose habits we are now to consider.

The burying-beetle lays its eggs in the putrescent flesh of reptiles, birds, or beasts; and, when the larvæ are developed in the form of maggots, they find this appropriate food pro-

vided for them by the instinctive foresight of their parents. But were the carcasses, so used, to remain above ground, exposed to the free action of the atmosphere, their decomposition would be carried on too hastily, or they might be devoured by those animals which feed on carrion, or many other accidents might befal them. The instinct of these beetles leads them, therefore, to serve a double purpose, by burying the bodies under ground; thus preparing a fit receptacle for their eggs, and, at the same time, removing a common nuisance. The manner in which they accomplish this useful office, is sufficiently curious, as the following experiment will show.

It had been observed, that dead moles, when laid upon the ground, generally disappeared in two or three days, and sometimes within twelve hours. In order to discover how this happened, a mole was laid in a garden, and the place marked. At the end of three days it was gone; and, upon digging where it had been placed, it was found buried three inches deep, and under it were four beetles. To be quite sure that these creatures were the cause of its disappearance, four of the same kind were put into a large glass vessel, half filled with earth, and covered over, so that they could not get out. Two dead frogs were laid on the surface of this earth; and two of the beetles immediately commenced their labours, on one of these bodies, with such vigour, that, in the course of twelve hours, it was completely buried. The other two were idle, during this operation; but, at last, their turn came, and the remaining frog was buried. A dead linnet was then put in. They began by pushing out the earth from under it, so as to form a hole for its reception, and then dragged at its feathers from below, to pull it into the grave. One of them at length seemed to quarrel with the other, and driving it off, carried on the work alone for five hours. He lifted up the bird, changed its place, turned it about, and, from time to time, coming out of the hole, climbed upon it, making apparently an effort to tread it down; and, when he had effected every thing that could be accomplished in this way, he again commenced his work beneath the surface. Being at last exhaust-

ed with so many hours of hard and incessant labour, he came out of his hole, and lay down on the ground without moving, for more than an hour. Again he commenced his work; and, next morning, the linnet was found to be sunk an inch and a half under the surface, with a trench all round it. In the evening, it had sunk an inch lower; and, in another day, it was quite covered up. Other small dead animals were afterwards put into the glass case, until, in fifty days, those four little beetles had buried no fewer than twelve bodies.

The last insect whose operations in propagating and rearing its offspring, I shall notice in this paper, is the ant, that little creature whose instincts bear, in some respects, a strong resemblance to those of the honey-bee, and, in some other respects, appear to be even still more remarkable. The ant-hills are wonderful structures, raised with great skill out of crude and unpromising materials, being composed of earth, moistened with rain or dew, kneaded with their teeth, and beat with their feet. So far as my subject leads me at present to describe them, I have to observe that there is a central apartment or royal cell, to which all the streets and lanes of their city converge, and in which are confined, for life, as in a state prison, their king and queen, two portly personages, whose size, superior to that of all their subjects, prevents them from escaping by the door through which the other denizens of the community find easy ingress and egress. There are various kinds of this insect, each of them remarkable for some peculiarities, but I speak at present of the white ant, one of the most active and singular of the species. Round the royal apartment are erected a number of nurseries for the young, as well as storehouses for the provisions. The storehouses are built, like the greater part of the nest, of earth, but the nurseries are formed of small grains of wood glued together. A pathway, half an inch wide, is often made, winding gradually upwards, within this high building, that it may be easier to climb, with their loads, from one part to another; and even a stair-case, or kind of bridge, resting on one vast arch, is sometimes carried, for the same purpose, from the top to the bottom

of this wonderful dwelling. Tunnels are bored by these little creatures all round their nest, to the distance sometimes of several hundred feet, and of enormous size, compared with that of the building, measuring occasionally nearly a foot across.

Here, as among bees, the important function of producing the future progeny, devolves entirely upon the solitary queen, who is said to lay the enormous quantity of twenty thousand eggs in the course of twenty-four hours. Like the queen bee, too, she is exempted, as well she may, from all the cares of nursing. This department devolves upon a particular class of the community, who show the utmost tenderness for their precious charge, and extreme solicitude for their welfare, carrying them from place to place in their mouths, as occasion requires, and even when their nest is laid open, exhibiting much more anxiety to place the larvæ out of danger, than to attend to their own personal safety. Among some species of ants, the nursing department is very laborious. As soon as the sun's first rays begin to shine upon the nest, the ants that are at the top go down in great haste to wake their companions; and all the young brood are then carried, and laid in the sun for a quarter of an hour. After this they require to be placed in other apartments where they may be warm without being scorched; and every evening, an hour before sunset, they must all be carried down into the lower cells, to be safe from the cold. They are to be hatched, in short, and kept warm by the genial heat of the sun, and the nursing ants must constantly attend to the state of the weather, and regulate their motions accordingly.

In all these instances, how astonishing is the power of instinct, which is accommodated, with such admirable discrimination, to the circumstances of each tribe, and is so full of new and most unexpected resources!

FIFTH WEEK—WEDNESDAY.

REPRODUCTION OF INSECTS.—GALL-FLIES.

One of the most remarkable of the breeding instincts with which we are acquainted, is that which the Author of Nature has bestowed upon the gall-fly family. There is known to be a principle of the vegetable kingdom, analogous, probably, to the *vis medicatrix* among animals, by which a puncture on the leaf, or bark of a tree, causes the sap to exude, and form a new growth of a peculiar description. It has pleased the Creator to make use of this principle, for the protection of the eggs and larvæ of the insects in question. For this purpose, He has bestowed a peculiar instrument for depositing the eggs; and, as is always the case where such an instrument is given, He has endowed the little animal with a corresponding instinct, that it may apply it to its proper use. Mr. Rennie, in his work on 'Insect Architecture,' in the 'Library of Entertaining Knowledge,' gives the following account of this instrument:—'In some of these insects the *ovipositor* is conspicuously long, even when the insect is at rest; but, in others, not above a line or two of it is visible, till the belly of the insect be pressed. When this is done to the fly that produces the current-gall of the oak, the ovipositor may be seen issuing from a sheath, in the form of a small curved needle, of a chestnut-brown colour, and of a horny substance, and three times as long as it at first appeared. What is most remarkable in this ovipositor, is, that it is much longer than the whole body of the insect, in whose belly it is lodged in a sheath; and, from its horny nature, it cannot be either shortened or lengthened. It is on this account that it is bent into the same curve as the body of the insect. The mechanism by which this is effected, is similar to that of the tongue of the woodpecker, which, though rather short, can be darted out far beyond the beak, by means of the hyoid bone,* being thin and rolled up,

* A forked bone at the root of the tongue.

like the spring of a watch. The base of the ovipositor of the gall-fly, is, in a similar way, placed near the anus, runs along the curvature of the back, makes a turn at the breast, and then, following the curve of the belly, appears again where it originates.'*

With this instrument the mother gall-fly pierces the part of a plant which she selects, and 'ejects into the cavity a drop of her corroding liquor, and immediately lays an egg or more there. The circulation of the sap is thus interrupted, and thrown, by the poison, into a fermentation, that burns the contiguous parts, and changes the natural colour. The sap, turned from its proper channel, extravasates and flows round the eggs, while its surface is dried by the external air, and hardens into a vaulted form.'† This is the account given by one of the older naturalists, and generally followed, though we may be permitted to doubt the deposition of the poisonous drop, which is purely conjectural, and seems unnecessary to account for the phenomenon. Mr. Rennie's conjecture is, that, like the saw-flies, the gall-fly, after the puncture is made, and the egg is pushed into the hole, covers the place over with some adhesive gluten or gum, or the egg itself may be coated over, like those of the moth, with such a gluten. In either of these two cases the gluten will prevent the sap that flows from the puncture, from being scattered or wasted; and the sap, being thus confined to the space occupied by the eggs, 'will expand and force outward the pellicle of gluten that confines it, till, becoming thickened by evaporation, and exposure to the air, it at length shuts up the puncture, stops the further escape of the sap, and the process is completed.'

But whatever the means may be, by which the effect is produced, it is perfect of its kind, and most admirably answers the end intended by the Almighty Contriver. In their most common form, the galls produced by means of these insects, may be found, in great numbers, during summer, on the

* Insect Architecture, pp. 371, 372.

† Spectacle de la Nature, vol i. p. 119.

leaves of the rose-tree, the oak, the poplar, the willow, and many other trees, in the globular form of a berry, about the size of a currant, and usually of a green colour, tinged with red.

When this pretty excrescence is cut into, it is found to be fresh, firm, juicy, and in the centre hollow, where there is either an egg or a grub safely lodged, and protected from all ordinary accidents. Within this hollow ball the egg is hatched, and the grub feeds securely on its substance, till it prepares for its winter sleep, before changing into a gall-fly in the ensuing year.

Most of the gall-flies deposit only one egg at a time, and, when that is the case, the gall generally assumes the form we have described; but the insect which makes use of the wild rose-tree, deposits several in one place, making probably as many punctures as she lays eggs. In this case there is a much more abundant flow of sap from the wounds, and the effect is singular and admirable. The sap, instead of being evaporated or lost, shoots out into a reddish coloured fibrous bristle, about half an inch long, studded all over with a kind of pricklets, not unlike the moss on the flower-shoot of the moss-rose. This substance, within which the embryos of the future grubs are placed, is called *bedaguar*, by botanists. It swells to the size of a crab or small apple, and forms a bulb, having the appearance of a tuft of reddish-brown moss, stuck on or round a branch. Each member of the congeries is found, on examination, to be furnished with its own tuft of bristles, arising from the little hollow globe in which the egg is lodged.

'The prospective wisdom of this curious structure, is admirable. The bedaguar grubs live in their cells through the winter; and as their domicile is usually on one of the highest branches, it must be exposed to every severity of weather. But the close, non-conducting, warm, mossy collection of bristles, with which it is surrounded, forms, for the tender grubs, a snug protection against the winter's cold, till, through the influence of the warmth of the succeeding summer, they undergo their final change into the winged state,—prepara-

tory to which, they eat their way, with their sharp mandibles, through the walls of their little cells, which are now so hard, as to be cut with difficulty with a knife.'*

Another structure, similar in principle, but different in appearance, is very common upon oak trees, the termination of a branch being selected, as best suited for the purpose. The structure is rather larger than a filbert, and is composed of concentric leaves, diverging from the base, and expanding upwards, somewhat like an artichoke. Whether this leafy substance is caused by a superinduced disease, as the French naturalists think, or, more probably, by the tendency of the exuding sap of the oak to form leaves, has not been ascertained; but that it is intended, as in the case of the bedaguar, to afford an efficient protection against the weather to the enclosed eggs or grubs, there can be no doubt.

That galls, of various kinds, are formed by the puncture of different species of flies, is evident, from what occurs upon the oak, on which are found two sorts of galls, of a structure quite different from that already described. One of these is the well-known oak-apple, which is commonly as large as a walnut, rounded, but not quite spherical. The skin is smooth, and tinged with red and yellow, like a ripe apple. At the base, there is, in its earlier stage, a calyx or cup, of a few small brown scaly leaves, but these fall off as the season advances. If an oak-apple be cut transversely, there is brought into view a number of oval granules, each containing a grub, and embedded in a fruit-looking fleshy substance, having fibres running through it; and, what is particularly remarkable, each of these fibres terminates in one of the granules, like a footstalk, or rather like a vessel for carrying nourishment.

The gall-insects are very various in their form and habits, some of them belonging to the tribe of aphides; and the galls they produce are not less diversified. These structures may be found on every part of a plant, whether branch, root, leaf, or bud. Nor are they confined to trees;—on thistles, on the

* Insect Architecture, p. 377.

ground ivy, and the germander, as well as on many other plants, they may be discovered. Some galls, found in foreign countries, are collected in great quantities for sale; and the gall-nut of a species of oak is particularly valuable, on account of its use as an ingredient in making common writing ink.

There is something so very striking in the creative contrivances and adaptations observable in this mode of providing for the safety and future subsistence of the progeny of these insects, as to afford peculiar satisfaction and delight to an ingenuous mind inquiring into the existence and attribute of the Great First Cause. Let us take a summary view of the whole process. The problem is, what new means may be employed for affording a secure asylum, furnished with appropriate food, to the embryo of certain races of living beings. Vegetable nature possesses a property, by which the sap, when exuded under very particular circumstances, will form itself into a round hollow excrescence; and this is fixed upon for the intended object. The animals whose offspring are to be thus reared, are furnished with eggs fitted to be hatched in such a situation, and to produce grubs whose food this very exudation shall afford. They are at the same time, supplied with a most curious instrument, elaborately formed and fitted in the most exact manner for making the particular puncture required in the plant selected; and then they are endowed with an instinct which enables them to choose the precise plant, whether tree, shrub, or flower, to which the egg, the future grub, and the instrument, are all most curiously adapted; and to choose also the proper part of the plant, whether leaf, branch, stem, or root; and, still further, to deposit their eggs at the critical season, when circumstances all combine most favourably for the required flow of the sap, and for the production of the grub in such time as to be ready for its state of hybernation when winter arrives;—all these, and various other circumstances, so evidently evince knowledge, contrivance, and forethought far beyond those of the animals

which they actuate, as to form a combination of evidence in favour of an Intelligent Creator, at once amazing and irresistible.

FIFTH WEEK—THURSDAY.

REPRODUCTION OF INSECTS.—DEPOSITION OF EGGS IN THE BODIES OF ANIMALS, AND IN INSECTS' NESTS.

Before leaving the subject of the maternal instincts of insects, I must not omit to mention that the same kind of analogy is to be found here which pervades other departments of the animated world, I mean that of one species of animals being reared or nourished at the expense of another. One or two examples of this provision, which, although somewhat startling on a first view, can yet be distinctly proved to be altogether consistent with that peculiar character of Divine wisdom and benevolence manifested in sublunary affairs, and productive of a preponderance of good, will be detailed in the present paper.

Yesterday some account was given of those very peculiar provisions by which the vegetable kingdom is laid under contribution for the hatching and rearing of the grubs belonging to certain species of flies, by the formation of galls. Such of my readers as are familiar with the analogies of Nature, will not be surprised to discover that, by a similar provision, the animal world is made to contribute to the same object.

No person who has resided in a rural district during the warm weather of summer, can be ignorant of that sudden and uncontrollable impulse which so frequently seizes an herd of cattle, known by the appropriate name of *Startling*—when they run off across a field in full gallop, with their tails poked out behind them, and their necks stretched to the utmost length. Virgil, in his 'Georgics,' gives a graphic description of this simultaneous fury of these naturally quiet and patient animals, which he justly attributes to the terror arising

from a little buzzing insect. The following is a nearly literal translation:—

> Around the groves of Silarus, and glades
> Of green Alburnus, buzzing sharp and wild,
> An insect pest appears—Asilus named,
> But Œstrus by the Greeks.—The madden'd herds,
> Roused by the hated sound, fly far and wide,
> While woods and arid banks of Tanagrus,
> Echo the lowings through the startled air.*

This terror does not appear to be occasioned by the pain of the inflicted wounds, for it is very doubtful if the ovipositor penetrates the skin, but rather by the well-known buzz of the insect. Were it otherwise, the cattle would, in all probability, lash the fly off with their tails. Their instinctive fear prevents this, and causes them to run recklessly forward, as we have seen, with extended tail, while the little animal is securely performing its parental office. The *startling* may be the means intended by the Creator to prevent an overproduction of the insect. Be this as it may, the egg glued probably to the scared animal's hair or skin, is soon converted into a grub, being hatched by the natural heat and perspiraton of the beast, and eats its way slowly under the skin, causing a lump as large as an acorn. The horse, the sheep, the reindeer, and various other quadrupeds, are subject to the same kind of annoyance; and the gall-bumps, made by the larvæ, are well known to those who have them under their charge. The farmer does not consider his cattle injured by the fly, which is said generally to select the young, and those which are in best condition.

There is a still more remarkable instinct of the kind I am now considering, similar to that which actuates the cuckoo,

> * Est lucos Silari circa illicibusque, virentem
> Plurimus Alburnum volitans, cui nomen Asilo
> Romanum est, Œstrum Graii vertere vocantes;
> Asper, ascerba sonans; quo tota exterrita silvis
> Diffugiunt armenta; furit mugitibus æther
> Concussus, silvæque, et sicci ripa Tanagri.
>
> *Geor.* iii. 146

that leads a certain class of *Ichneumon** flies to deposit their eggs in the nests of other insects. It is, indeed, the practice of a great number of insects of different orders and families, to take advantage of the labours of others of the same genus, in providing for their future progeny. The example which I shall now select, may serve as a curious specimen of this instinct.

The ovipositor of all the true ichneumons is similarly constructed, consisting of a borer enclosed in a sheath, which opens through its whole length, like the legs of a pair of compasses. It is longer or shorter, and stronger or more slender, according to the substances which it may be necessary to penetrate when the eggs are deposited; but the description of the ovipositor of the fly, of which I am now about to give an account, may suffice to give the reader a tolerably distinct notion of the others. Being intended to penetrate into the deep holes dug by mason-wasps, the ovipositor of this insect is nearly three inches long, and as it is not concealed in the body like those of the gall-flies, it appears like a tail formed of a long black bristle. On examining this a little more narrowly, we find that what appears to be a single bristle is in reality three, the two side ones forming a sheath, and the middle one a borer or brad-awl, for piercing the clay barricado of the mason-wasp's nest. The termination of the borer is not, however, smooth, like that of a brad-awl, but toothed like a saw, only the teeth (seven or eight) are not oblique, but perpendicular, a form better fitted for acting upon clay, as the teeth will not become so easily clogged, and the instrument will be more readily drawn back.

That the nature and intention of the operation within, may be understood, it will be proper that I should first describe the nest of the mason-wasp. It is a narrow hole of about three inches deep, hewn with her jaws in an indurated sank-bank. In the bottom of this nest the careful wasp, after depositing her egg, collects about a dozen full-grown caterpillars of a green kind, which she deposits alive, packing them one upon

* Signifying 'Pryer.'

another, in a spiral form, for they naturally roll themselves up as soon as they are at rest. Having in this way provided for the wants of her offspring in the grub-state, the mother wasp seals up the cell with kneaded clay, thus leaving it apparently well secured both against famine and living foes. It is this nest which the ichneumon fly chooses as the cradle of her own progeny. Reaumur, from his own observation, gives an interesting account of the manner in which this insect effects its purpose. 'I perceived,' says he, 'one of these ichneumons, at the instant it alighted upon the spot, under which so many of the little green caterpillars had been stored up by the wasps. Its long tail, which it carried horizontally, appeared to form but one bristle, though it was really composed of three; and though it carried it on a line with its body, it soon showed me that it was capable both of raising and lowering it, as well as of bending it in various directions, and in different proportions to its length. It moved its ovipositor, so as to bring it into a bent position under its body, protruding it even beyond its own head; taking care to direct it into the barricaded nest of the mason-wasp. But, although the insect appeared not to be disturbed by my observations, yet I was unable to perceive whether the toothed portion of the borer was pushed beyond the sides of the sheath. What I did see, however, convinced me that the instrument was worked in a manner well adapted to make its way through the mortar; for she turned it half round alternately from left to right, and from right to left, as a carpenter would his brad-awl, and employed more than a quarter of an hour, before she succeeded in penetrating to a sufficient depth.'*

It is thus that the ichneumon contrives, without any labour of her own, but simply that of inserting her ovipositor, to find a place of safe deposit for her egg, and of plentiful subsistence for her offspring when hatched. As soon as the grub of this intrusive insect becomes animated, it begins to feed on the prey which its mother has so artfully provided for it,—de-

* Reaumurs's Mem. vi. p. 340.

vouring indiscriminately the larvæ of the wasp, and the caterpillars which the industrious creature has stored up for the subsistence of its own progeny. There is something very singular in these instincts and counter-instincts by which the reproductive principle is at once urged forward and kept within proper check, and by which one animal is made to collect the prey on which the offspring of another is so frequently destined to feed. We may not be able to penetrate all the intentions of Creative wisdom in the cases we have been now considering; and indeed at every step we are forced to confess that the ways of the Eternal are not as our ways, but we assuredly see enough even here to afford us the conviction that an intelligence and a bounty far exceeding our conception, have planned and executed these amazing operations.

FIFTH WEEK—FRIDAY.

REPRODUCTION OF BIRDS.—THEIR EGGS.

Confining myself, for the present, to land-animals, and passing over the reptile tribes, in whose reproductive habits there seems to be little known that is peculiar to the genius, we come at once to that family, which, of all lower tribes, is the most interesting, and whose reproductive instincts and functions, above all, furnish to the lover of nature, such varied sources of elegant amusement and instructive study. I need hardly say that I allude to the feathered tribes.

On entering upon the subject, the first thing to which I will turn the attention of my reader, is the egg, and the various phenomena which occur during its development. The physiologist, as well as the naturalist, has directed his inquiries to this curious and interesting department, and few things have been studied with greater care than this production, which contains, in circumstances convenient for experiment and investigation, the mysterious germ of animal existence.

In external shape, the eggs of all birds are constructed on the same model, some of them, indeed, approaching nearer to a globular form than others, but all of them being more or less elongated, and, in general, having one end very perceptibly smaller than the other. In this respect they differ considerably, in their external appearance, from the eggs of the insect tribes, the form of which is exceedingly diversified. There is always a wise reason both for the uniformity and diversity of the Creator's works; and we shall err egregiously, if we ever imagine that, in these operations, we observe anything approaching either to caprice, or a wanton love of variety. It is true, that the differences in natural objects are manifold and incalculable; and these endless dissimilitudes might lead a careless observer to imagine that they were sometimes resorted to, merely for the sake of change. But a more minute survey will correct this hasty conclusion, and we shall find, that the more intimately we become acquainted with the relative connexions and adaptations of things, the more firmly will the conviction be impressed on our minds, that there is a wise, a sober, and a satisfactory reason for every department and minute feature of the Creator's workmanship. Thus there is an obvious cause of diversity in the shape of insect eggs, connected with the diversity of forms in the various tribes of insect existences; while among the races of birds, there is such a general uniformity, or at least analogy, of forms in their bodies, as readily to account for the similarity in the figure of their eggs. This view is confirmed, by considering the respects in which they differ. In size, birds materially vary; and, in this respect, we observe a like diversity in their eggs. I by no means assert, that the size of the egg bears always an exact proportion to the largeness or smallness of the bird from which it proceeds; for I am aware that this is not correctly the case; but there is here a distinct adjustment, within certain limits, which indicates intention; and the very deviations from the general rule would, doubtless, were all circumstances known, only serve to confirm it.

But, leaving the external appearance of the egg, let us con-

sider what is its constitution within, and the gradual development of the future animal, which so mysteriously proceeds. The egg, as it presents itself to the eye, when opened and examined before incubation, consists, as every one knows, of two substances,—a yolk, surrounded with a tough and transparent matter, called the albumen, or white. In the surface of the former, there is a transparent gelatinous molecule, invested with three pellicles, which constitutes the embryo of the future bird. And here a remarkable mechanical contrivance meets us at the outset. It is of great importance to the development of the animal, that this germ or cicatrice, as it is called, should be always kept particularly warm, by the heat of the mother's body, during incubation. This is provided for by a peculiar and beautiful apparatus, minutely described in the late edition of Paley's Theology,* and illustrated by diagrams. It is enough for our purpose at present, to state, that the contrivance is such as to insure the revolving of the yolk, whichever way the egg is placed, so as to cause the germ to be always uppermost, and thus situated nearest to the body of the bird when she sits upon it.

In watching the progress of development during incubation, the first opaque object discoverable by the eye, is a small dark line, called the primitive trace, formed on the surface of the outermost pellicle. Two ridges then arise, one on each side of this dark line; and, by the union of their edges, they soon form a canal, containing a deposit of a semi-fluid matter, which, becoming darker and firmer, discloses two delicate threads, placed side by side. These are the rudiments of the spinal cord, from which springs the nervous system, so essential to the whole animal being. Next to this fundamental part of the structure, follows the first appearance of the vertebræ, which are seen in the form of minute dots, arranged in two rows, one on the outer side of each of the filaments already mentioned. These soon after form a series of rings embracing the spinal marrow. The formation of these elementary parts of the spine, is followed by the development

* Knight's edition, vol. ii. pp. 284, 285.

of three white tubercles at its upper end, which are the foundations of the future brain. It is remarkable that these first rudiments of the brain correspond to the permanent condition of that important organ in the inferior fishes. They are, however, in birds, quickly folded together into a rounded mass; and meanwhile, the two filaments of the spinal cord have approached and united into one column, the form which they ever after retain. The rudiments of the eye and ear appear even at this early period.

The plan, as it were, of the future edifice having thus been sketched, provision begins to be made for the superstructure. The nutrient juices must for this purpose be brought into circulation, and, by-and-by, certain opaque globules are seen to meander unconfined through the mass of jelly; presently a circular vessel is discovered, along which the fluids irregularly undulate backwards and forwards. A delicate net-work of vessels now begins to appear, which by degrees shoot out in various directions, forming trunks and branches, so as to establish a more regular system. And now, for the first time, the rudiments of the heart are observed at a central point, where the folding of the middle membrane forms first a groove, and then a sac, extended soon afterwards into a tube. To this essential organ, the blood-vessels, previously formed, are gradually united by their shooting out in that direction; and thus the uniform circulation of the blood is established, and the heart, or *punctum saliens*,* as in this part of the development it is called, begins to exercise its functions, as is testified by its quick and regular pulsations. It is still only a lengthened tube, but it soon shows three protuberances, which are the cavities of the future auricle, ventricle, and bulb of the aorta. Afterwards it assumes a rounded shape, by the folding of its parts, the whole of which are coiled, as it were, into a knot; by which means the heart gradually takes the form it is permanently to retain.

When the circulation of the blood is thus established, the digestive organs begin next to appear. Two laminæ are

* Jumping spot.

formed from the folds of the innermost of the pellicles which invest the embryo, and these, uniting, constitute a tube, which gradually expands into several dilated portions, to be afterwards converted into the stomach, crop, gizzard, &c. These new organs, even in this rudimental state, very soon begin to exercise their proper office, by receiving into their cavities, through a tube, temporarily provided for that purpose, the fluid of the yolk, which they prepare into nourishment.

Aeration, as it is called, or an internal communication with the atmosphere, is essential to animal life. This is first provided for by a set of temporary vessels spread over the membrane of the egg, and communicating with the blood-vessels, which receive the oxygen of the air through the pores of the shell, and convey this necessary influence to the blood. The lungs, not being required to exercise their functions till the chick is excluded from the shell, are among the last organs that are formed. The rest of the apparatus necessary for aeration is also tardily constructed, for a similar reason. The construction of the heart, in its early stages, resembles this simple organ in fishes, because the fœtus is placed in circumstances analogous to those of aquatic animals; but, by degrees, the heart is divided into two compartments; the auricle also, by a different process, becomes double, as well as the main artery, which last is afterwards separated into two distinct vessels, the one forming the aorta, and the other the pulmonary artery; and thus a foundation is laid for the double circulation, which the future condition of the animal is to require.

It is not necessary, in a work like this, and it might be tedious, to follow the rest of these wonderful processes through the development of the bony skeleton, the flesh, and the skin, with the various organs of sense and of motion, till the perfect animal is formed.* Enough has been said to introduce the reader to a new world of wonders, in which the adapta-

* If the reader be desirous to know the time when the various developments become visible, the following summary may satisfy him.

At the end of the second day, the heart appears to beat.

At the end of 48 hours two vesicles of blood are seen, with a visible pulsation.

tions and contrivances are not less striking indications of creative skill and forethought, than in any other part of the operations of Nature. Dr. Roget concludes his elaborate account of organic development, with the following sensible remarks, which, in few words, express the views naturally arising from the contemplation of these astonishing operations, and which seem appropriately to sum them up:—

'We cannot but be forcibly struck with the numerous forms of transition through which every organ has to pass before arriving at its ultimate, and comparatively permanent condition. We cannot but wonder at the vast apparatus which is provided and put in action, for effecting all these changes; nor can we overlook the instances of express contrivance, in the formation of so many temporary structures, which are set up, like the scaffold of an edifice, in order to afford the means of transporting the materials of the building in proportion as they are wanted; nor refuse to recognize the evidence of Provident Design, in the regular order in which the work proceeds; every organ growing at its appointed time, by the addition of fresh particles, brought to it by the arteries, while others are carried away by the absorbents, and are gradually acquiring the form which is to qualify it for the performance of its proper office in this vast and complicated system of animal life.'*

At the 50th hour, one auricle of the heart appears.

At the end of 70 hours the wings, and two bubbles, afterwards to form the brain, are distinguishable, as well as one for the bill, and two for the fore and hind part of the head.

Towards the fifth day the liver appears.

At the end of 131 hours the first voluntary motion is observed. In seven hours more the lungs and stomach become visible, soon followed by the formation of the intestines, the loins, and the upper-jaw.

At the 190th hour the bill opens, and the flesh appears on the breast.

On the 210th hour the breast-bone, the ribs, the bill, &c. are visible.

Towards the 240th hour, the feathers begin to shoot out.

At the 264th hour, the eyes appear.

At the end of 355 hours, the bill frequently opens and shuts, and the first cry is heard.

* Roget's Bridgewater Treatise, vol. ii pp. 617, 618.

FIFTH WEEK—SATURDAY.

REPRODUCTION OF BIRDS.—PROSPECTIVE CONTRIVANCES.

'On contemplating,' says Dr. Roget, 'the infinitely diversified chain of means and ends, and of causes and effects, which, during the construction and assemblage of the numerous parts composing the animal machine, are in constant operation, adapting them to their various purposes, and combining them into one efficient and harmonious system, it is impossible not to be deeply impressed with the extent and the profoundness of the views of Providence, which far exceed the utmost boundaries of our vision, and surpass even the powers of the human imagination.'*

The truth of this remark must appear striking and obvious, even in the very short, but, I believe, correct view which I yesterday gave of the progress of animal development, as exhibited in the chick, while yet enclosed in the shell. If we follow the process a little farther, we shall add still more to the proofs of Creative Intelligence, and beneficent intention.

I begin, by observing, in general, that the whole animal apparatus is formed in the egg, not for immediate, but prospective use. At first there is a mere jelly, or what appears to be so; a little farther advanced, and there are bones, and muscles, and nerves. But these lie quite inactive for a long time; the nerve excites no action; the muscles do not move; the joints are not exercised, and are perfected slowly. The period of full development is not arrived; they have not yet received their stimulus to activity. The whole, then, is in a state of preparation. Conduit-pipes without their fluids; glands and ducts without their secretions; sensibilities dormant; and a mechanism quite inoperative: a whole animal system beautifully contrived, but only in prospective contri-

* Roget's Bridgewater Treatise, vol. ii. p. 600.

vance.* Paley makes a similar remark regarding the single organ of the eye and of the lungs. Adverting to the latter, he says, in his own graphic style, 'composed of air-vessels where there is no air, elaborately constructed for the alternate admission and expulsion of an elastic fluid, where no such fluid exists, this great organ, with the whole apparatus belonging to it, lies collapsed in the fœtal thorax; yet in order and in readiness for action, the first moment that the occasion requires its service. This is having a machine locked up in store for future use; which incontestibly proves that the case was expected to occur in which this use might be experienced; but expectation is the proper act of intelligence. Considering the state in which an animal exists before its birth, I should look for nothing less in its body than a system of lungs. It is like finding a pair of bellows in the bottom of the sea, of no sort of use in the situation in which they are found; formed for an action which was impossible to be exerted; holding no relation or fitness to the element which surrounds them, but both to another element, in another place.'†

The temporary contrivances noticed in the previous paper, which are intended to answer the purposes of life in the fœtus, while it remains enclosed in the egg, and which are absorbed and disappear as soon as they have accomplished their object, form a kind of counterpart to those which are prospective, and are no less indicative of design. They are like the wooden frame of an arch, which is necessary for carrying on the work, yet it is to be taken down as no longer of use, but the contrary, when the structure is finished. A temporary contrivance of this kind exists in the *bill-scale*, as it is called, of the chick, which is intended, evidently, for no other purpose than that of a hammer to enable the imprisoned bird to break open the door of its jail, and which drops off a few days after it is hatched. This instrument is a small, sharp

* Sir Charles Bell's Note in Paley's Natural Theology, vol. i. pp. 317, 318.

† Paley's Natural Theology, vol. i. pp. 315, 316.

and hard protuberance on the bill of the chick, which is of itself then too soft to answer this important end, being, at this stage, left in such a state, doubtless, for some object connected with the welfare of the bird. It is curious to remark an instance of the striking uniformity of instincts, in the manner in which the chicks of all species employ this temporary instrument for their extrication. M. Reaumur found, that all chickens chip the shell in the direction from left to right; and that the circle in which they chip invariably cuts the egg at right angles to its transverse axis, and never obliquely.

Another remarkable provision, with relation to the welfare of the chick, immediately before and after its extrusion from the shell, is found in the yolk. The white, or albumen of the egg, goes to the nourishment of the chick while the process of development of organs is proceeding; but the yolk is embraced in the body of the young bird, before it arrives at a state which fits it for living in the open air, and a duct leads from the membrane enclosing this mass of nutriment into the first intestine; and thus is the chick nourished during its first feeble existence.

Add to all this, the formation of a kind of down over the greater part of the body of the chick, while it is yet enclosed in the shell, to serve as a temporary protection to its body when first exposed to the weather, and to afford time for the production of the feathers, which could not conveniently be produced within the narrow and compact bounds of the egg.

There is yet another general observation which I may make here, though it relates to another branch of the process of reproduction—I allude to the well-known fact elsewhere incidentally stated, that some of the larger birds lay fewer eggs than the smaller. There is, in this, a very remarkable attention to what is called the balance of animal nature. Birds of prey breed slowly; those which are the objects of prey breed rapidly, and in profusion. Thus, the eagle, the condor, and the vulture, lay but two eggs at a time, and produce only once in the year. The falcon, the hawk, and the owl, with all their rapacious congeners, produce also sparingly. The

wren, on the contrary, lays ten or even fifteen eggs, and rears this numerous offspring, that they may serve, as it were, to supply the wants of the predatory tribes, to whom their feebleness and unprotected condition render them an easy prey. And so with many other birds. They are prolific in proportion to their exposure to accidents or to enemies; and thus the species is preserved, notwithstanding the destruction to which they are destined. This is a kind of provision which runs through animated nature, and, singular as it is, manifests Creative Intelligence, and that kind of analogy, which, in so many particulars, unites the various departments of creation under one character, and distinguishes the whole as the work of one Almighty Hand.

All these circumstances, which relate to organic reproduction in the first stages of a bird's existence, are so obviously proofs of Divine Wisdom, that they require no further comment; but the argument which they furnish derives particular interest and force from the instincts, with which these developments are connected in the parent bird, which so beautifully harmonize with them, and without which, the powers inherent in the embryo would never be brought into action. This will form materials for some subsequent papers; but before I proceed to this interesting part of my subject, a few observations seem to be called for on the peculiar form and structure of birds, with reference to the element through which they are intended to move. We shall here find no less striking evidences of the contrivances and adaptations of a Creating Mind.

SIXTH WEEK—SUNDAY.

REGENERATION.

Spring is the season when all the operations which tend to reproduction, are carried on. Mysteriously, and far beyond human ken, is the sap rising in the plant, the bone grow-

ing in the womb, and the pulpy matter of the egg assuming the more solid form of nerves, sinews, bones, and even feathers. The eye of inexperience, on examining these first rudiments of organized matter, could, by no skill or ingenuity, imagine the result of the perfected work. A confused gelatinous mass, with a dark speck in the centre, or, at a more advanced stage, a few dark thready-like lines, would little suggest the form of the creature, instinct with animation, and buoyant with the joy of life. We know not 'the works of God, who maketh all,'—we can only admire and adore. But there is a greater, a more mysterious work, and one higher in its aim, continually in progress. I mean, the hidden work of the Holy Spirit upon the spirits of human beings. It is higher in its aim, because it is not the formation of an organized, and material, and perishable creature, which fulfils its functions for a time, and then returns to its parent earth; but the formation of a spiritual and imperishable being, that must return, in a holy and perfect state, to the God who gave it birth. Well may any man, in the darkness of the carnal character, say with Nicodemus, 'How can these things be?' How can that which has unresistingly obeyed the law of the members, turn itself to the obedience of a holy and spiritual law? How can the servant of sin become sin's master? How can he, who has found the Sabbath a weariness, and, if he ever tried spiritual prayer and praise, has discovered them to be impracticable exercises for him, join with a joyful heart in those holy occupations, which prepare God's own children for the inheritance of the saints in light? How can these things be? Wonderful transformation!—Unseen, mysterious, but growing apace; strengthening and expanding as it grows, and as certainly bringing forth new volitions and new exercises, as the living thing that is formed in the shell, will, when it comes forth, perform all the functions of life.

The first approaches to life are generally feeble and nearly imperceptible; and it is not till they have acquired a degree of strength, that we really ascertain life to be there. So, frequently in a Christian land, and especially with those who

have been nurtured in Christian families, the first tokens of spiritual life are dubious and faint. Those who have experienced the blessed change, and have attained to something of the statute of perfect men in Christ Jesus, recall the first pang of conscience upon some known transgression, painful and pungent for a while, and then dying away, and leaving no important trace. The first careful thought of the broad way leading to destruction, and the narrow way leading to life, producing, peradventure, some anxiety and some resolutions against sin; the first affliction, or anticipated affliction, exciting the dread of bereavement, and the consciousness of dependance, and leading to the Hearer of Prayer, is something better than the mere formal temper in which past prayers have been employed. These feeble tokens may be quenched in their first struggle for existence, or they may be cherished into life and strength. O, beware how you treat them. Feeble though they be, they are the work of the Spirit.—They have the germ of immortality in them. Destroy them not, for a blessing is in them. Rejoice on account of them, they come from God; they contain the rudiments of an immortal intelligence, they are the embryo of an heir of glory. On you, who experience them, lies the obligation to endeavour to quicken their growth, and to speed their extension over the whole of your character.

Your *will* must be new in all its features. Naturally it was headstrong, resolved to have its way, running blindly headlong to perpetrate its purposes. Saul thought it his duty to torment the church of Christ. He rushed on from zeal to greater zeal, from afflicting the saints at Jerusalem, to pursuing them to a distant city; and, not content with taking the leaders as his mark, the feeble women were not exempted from bonds and imprisonments. His will seemed invincible. But, behold the man, convinced that the Jesus whom he persecuted is both Lord and Christ, and what is the result? His will is subdued,—it is become pliant,—it is waiting and longing for guidance,—'Lord, what wilt thou have me to do?'

Your *affections* must be all made new. Matthew, the tax-

gatherer, left the receipt of custom, gave up the occupation by which he had his living, to follow after him whom he learned to love as his Guide and Redeemer. Zaccheus, whose wealth had been obtained by extortion, not only foregoes dishonest gains, but restores fourfold what he had taken unjustly. Nay, more, his mind is so humbled, that he owns to Jesus, in the hearing of many, that it has been his habit to take unjustly. Here is a complete overturn in the whole man. The world is no longer the keen object of his pursuit. He has become liberal to those whom it was his gratification and earnest desire to rob in time past; and, in addition to this, he feels so sure that he hates the ways he once delighted in, that he draws near to his Saviour, with confession of past sin, and the expression of resolutions for the time to come. Here are new affections, indeed. Have we experienced them? Are we ready to sacrifice the earthly things, the corrupting things, the vain things, which have occupied our lives, and formed our business and delights, that we may devote ourselves to the Holy One, who sacrificed himself for us?—Or rather, do we feel it no sacrifice? Would it be our punishment now to pursue these things? Are we sensible that our hopes, our fears, our joys, are changed? Then, whether the process has been slow and gradual, or whether it has been by instantaneous and overpowering conviction, the change is wrought, the new creature is formed, and that new formation is the work of the Spirit of God.

Say not that you are not renewed in the spirit of your mind, because you do not feel the change perfect. Since man, in his fallen state, is but a ruin, and what has been thrown down must be repaired, be not surprised if it is not a perfect work at once. The change can be and must be complete, though it be not perfect. You must be renewed in the *whole* man, though the whole man still go halting, by reason of the fall. The babe does not learn to go alone in a day or a year, yet every day approximates to that period of its advancing strength. Only ascertain that it possesses real life and health, and be assured that it will advance till it attain maturity. 'One

stroke of the chisel does not make a statue;' neither does one pang of contrition, one good resolution, or one prayer, make a child of God. But the Lord himself is engaged on the side of those who seek to turn to him. He has told us of the heavenly temple, whose stones are polished, and fitly joined together, he himself forming the chief corner stone. Put your case, then, into his hands. It is his care and concern, with which yours now co-operate, that must finish the work. Repeated and renewed strokes of the chisel may be requisite; he is faithful, he will not withhold them. If you be still unconquered in will, he can vanquish you by some soul-subduing affliction; and he will do this, if your perverseness forces him to it. If your affections be still unweaned or unpurified, he can destroy the objects in which they centre, or take away, with a stroke, the creature that draws your spirit earthward; and this his faithfulness constrains him to do, rather than that the birth of your soul should be rendered abortive. Say not, then, 'How can these things be?' but ask of Him, for whom 'nothing is too hard,' to form in you that new creature, without which nothing else availeth you. He who caused your bones to grow at first, without any leave asked of you, will not fail to complete the weighty concern of forming you anew, after his own image. And though the work may be hid for a time from all bystanders, and though you may occasionally be unable to discriminate the natural motions of conscience, and the accumulating light of your own understanding, from the emotions and helps of the life-giving Spirit, yet fail not to go forward. He knoweth his own work, and will recognize it; and the fruits of the Spirit will presently be manifest to those around you, while they are filling the hidden man of your own heart with love, joy, and peace.

But, says some reader, I do not know—I cannot learn whether this mysterious work is begun in me or not. It is an occult concern, it seems, as little to be observed as the growth of the chick in the egg,—how then can I observe it? True! you, who dwell on the outside of the shell, discern not the process

within; you see not what is in the bosom of your neighbour; but have you ever tried to examine what is in your own? There is one discerning eye that observes it all, and perhaps at this moment remarks your difficulty, as but a cavil raised up for an excuse. Well, I will give you one test by which you may try whether this mysterious work is begun in you or not. God desires his children to be 'ever' with him. He has made arrangements, which will enable them to learn the song of Moses and the Lamb, and to unite themselves with the blessed throng who give glory to his name for ever. And, preparatory to these employments, he teaches them to be fervent in prayer and supplication; to unite their hearts in thanksgiving and praise. Can you do this? *Try it.* This is my test. If you cannot find food for prayer in this world of many necessities, how shall you find employment for praise, in a region where necessity, and want, and pain, and fear, have no existence? If you do not enough adore redeeming mercy, to give thanks for it here,—if your heart cannot commune with God for half an hour in this state, would his eternal presence and unceasing communion be less than intolerable to you in that country, where all behold, and enjoy, and adore? This test is simple, and it is infallible. O do not turn from it, till you have tried it. Haply, it may be the means by which Divine grace shall cause the first pulse of spiritual life to awake in your heart.

M. G. L. D.

SIXTH WEEK—MONDAY.

BIRDS.—RELATION OF THEIR BODIES TO EXTERNAL NATURE.

The evolution of the chick in the egg, may be taken as an example of the earliest processes of animal organization in general, because, such is the analogy of nature, that the *plan* by which the embryo of all the higher species of animals is developed, whether in the egg or in the womb, is nearly the

same. But there are certain peculiarities in the form and modifications of the bodies of birds, intended to suit them for the element in which they are destined to move, very striking as indications of design, to which, before leaving the subject of organization, it is desirable to advert. I take the general scope of the argument from Paley, with the illustrative observations of Sir Charles Bell.

Birds are intended for the very peculiar function of raising themselves above the earth, and transporting themselves from place to place, through the air; an achievement which must appear, at the very first glance, to require a peculiar conformation of body. We are familiar with this action of birds, and are therefore apt to pass it over without much observation; but if any one divesting himself of his previous knowledge, could sit down to try, without the aid of experience, how the matter could be managed, he would soon find that the problem was by no means an easy one. The first thing which would strike him, would be the difficulty of causing a body, specifically heavier than the atmosphere, to float in that element. If this were overcome by the aid of dynamics, he would immediately find other questions arising, for an answer to which, that science must also be appealed to; the means of equipoise and voluntary progression, the best mechanical contrivances, at once for lightness, and for strength of structure, the forces most skilfully adapted for cutting the air, for passing through it with pleasure in all directions, for resisting the current of the wind, and flying against it; the most advantageous conformations of the external covering of the body; the shape of the wings best calculated for soaring, for rapid flight, for alighting, for fitting gracefully and easily to the body, when at rest,—all these, and a thousand other inquiries would occur to him, involving the laws both of solids and of fluids, till he would find himself lost in the intricacies of the subject, and be forced to confess that he who could conquer all its difficulties, must, to say the very least, be possessed of no ordinary accomplishments. Now, all these questions have certainly been considered, and solved in

forming the body of a bird, with relation to its aerial functions. Let us look at a few of them.

The first query is, How a creature, which has to exercise the same animal functions as quadrupeds, shall be able to rise into the air. Contrivances must, of course, be resorted to, for rendering its body as light as is consistent with other conditions. What has actually been done with this view? In the first place, the body of the bird has been enlarged, without increasing the weight in nearly the same proportion. The windpipe of the swan and crane is adduced by Sir Charles Bell, as an instance of this; and he has given a drawing illustrative of the curious convolutions which this member undergoes, within the sternum or breast-bone of the bird. 'The light and hollow air-tube fills a space in the interior of the bone, by which the surfaces are extended for the attachment of the muscles of the wings, and thus two objects are attained through it.'*

But there is a still more curious provision for the extension and magnitude of the body of the bird, independently of weight. In birds, the air does not only pass *into* their lungs, but *through* them, so as to fill a series of air-cells, composed of fine membranes, which are interwoven with all the intestines. The heart is surrounded with such a cell. Two great cells are attached to the liver; and in the same manner, are all the viscera of the abdomen interspersed with air-cells, and these all communicate. The air, thus admitted into the interior of the body, extends even into the bones.

'In comparing the bones of animals,' says Paley, 'we are struck, in the bones of birds, with a *propriety*, which could only proceed from the wisdom of an Intelligent and Designing Creator. In the bones of an animal that is to fly, the two qualities required are strength and lightness. Wherein, therefore, do the bones of birds (I speak of the cylindrical bones) differ in those respects from the bones of quadrupeds? In three properties; first, their cavities are much larger, in

* Appendix to Paley's Natural Theology, Knight's edition, vol. ii. p. 279.

proportion to the weight of the bone, than in those of quadrupeds; secondly, these cavities are empty; thirdly, the shell is of a firmer texture than in the substance of other bones. It is easy to observe these particulars, even in picking the wing or the leg of a chicken. Now, the weight being the same, the diameter, it is evident, will be greater in a hollow bone than in a solid one, and with the diameter, as every mathematician can prove, is increased, *cæteris paribus*, the strength of the cylinder, or its resistance to breaking. In a word, a bone of the *same weight* would not have been so strong in any other form; and to have made it heavier, would have incommoded the animal's flight.'*

Connected with the subject of weight, is the contrivance of making birds *oviparous*, by which means the important work of gestation goes on with as little increase as possible of the weight of the body. It is well known, that birds of prey sometimes gorge themselves to such excess, that they are unable to rise on the wing, a proof that the burden of offspring in the womb, would have been unsuitable to the purposes of flight. The advantage, in this respect, of an oviparous procreation is, that, while the whole brood is hatched together, the eggs are produced singly, and at considerable intervals.

Paley draws an argument for design, by comparing animals with regard to their *instruments of motion;* and here also the contrivances which fit the bird for its peculiar motions, are very admirable and peculiar. In comparing feet, wings, and fins, he exclaims, 'I desire any man to say which of the three is best fitted for its use, or whether the same consummate art be not conspicuous in them all.'

After noticing the striking analogy which subsists between a wing and the fore-leg of a quadruped, he goes on to say:— 'Fitted up with its furniture of feathers and quills, it becomes a wonderful instrument, more artificial than its first appearance indicates, though that be very striking. At least the use which the bird makes in flying, is more complicated and more curious than is generally known. One thing is certain, that

* Paley's Natural Theology, Knight's edition, vol. ii. p. 277.

if the flapping of the wings, in flight, were no more than the reciprocal motion of the same surface, in opposite directions, either upwards or downwards, or estimated in any oblique line, the bird would lose as much by the one motion as she gained by the other. The sky-lark could never ascend by such a motion as this; for, though the stroke upon the air, by the underside of the wing, would carry her up, the stroke from the upper side, when she raised her wing again, would bring her down.' Having started this difficulty, our author proceeds, by a description of the form of the wing, and the action of the muscles and joints of the pinions, to show how successfully it is obviated, and how distinctly there are exhibited, in this mechanism, evidences of skilful contrivance. He then speaks of the tail as an instrument of steerage, and adds, 'Herein we meet with a circumstance not a little remarkable. Birds with long wings have short tails; and, in their flight, place their legs close to their bodies, at the same time stretching them backward as far as they can. In this position, the legs extend beyond the rump, and become the rudder, supplying that steerage which the tail could not.'*

In another part of his work, Paley gives his celebrated description of a feather, in which he demonstrates that it is, for strength, lightness, elasticity, and resistance to the air, what he happily calls a mechanical wonder. I must not occupy so much room as would be necessary for doing justice to this admirable analysis; and shall conclude with the animated observations with which he introduces it. 'The covering of birds cannot escape the most vulgar observation: its lightness, its smoothness, its warmth,—the disposition of the feathers, all incline backward, the down about their stem, the overlapping of their tips, their different configuration in different parts, not to mention the variety of their colours, constitute a vestment for the body, so beautiful and so appropriate to the life which the animal has to lead, as that, I think, we could

* Paley's Natural Theology, Knight's edition, vol. i. pp. 280, 281. See this subject further discussed in 'Summer,'—paper on 'The Power of Flying.'

have had no conception of any thing equally perfect, if we had never seen it, or can now imagine any thing more so. Let us suppose (what is possible only in supposition) a person who had never seen a bird, to be presented with a plucked pheasant, and bid to set his wits to work, how to contrive for it a covering, which shall unite the qualities of warmth, levity, and least resistance to the air, and the highest degree of each; giving it also as much of beauty and ornament as he could afford:—He is the person to behold the work of the Deity in this part of His creation, with the sentiments which are due to it.'*

SIXTH WEEK—TUESDAY.

BIRDS.—THEIR REPRODUCTIVE INSTINCTS.—PAIRING.

THE instincts of birds intended to give efficacy to that great object, the preserving of successive generations of the species, are not less admirable than the organic mechanism which has been described, as constructed with the same design. The first of these instincts, in the order of time, is that which leads birds to pair.

Early in spring, almost every little songster of the grove is found to have chosen a mate, to which he remains faithful, till the young brood,—the offspring of their mutual loves, and the object of their tender cares,—have become able to provide for their own subsistence. In this respect, they approach nearer the human race than any other of the lower animals. Male insects, so far as we know, never share in the parental cares of the female. In some few instances of insects living in communities, these domestic duties are performed by a separate caste, as we have already seen in the case of bees and ants; in all other instances, the task seems to fall exclusively on the female.

The males of quadrupeds are, in the greatest variety of

* Paley's Natural Theology, Knight's edition, vol. i. p. 250.

cases, not more observant of the wants of their future off spring than those of insects; though there are considerable exceptions to this rule, among those classes of the brute crea tion which burrow in the earth, or whose progeny are long helpless and dependant. This matter, indeed, is regulated like every other provision of Creative Intelligence, with sin gular adaptation to the wants and circumstances of the species. Where animals suckle their young, as is the case with quadrupeds, the attentions of the male are seldom required, the necessary food being at hand; and, in the case of insects, the eggs are usually deposited where the larvæ, as soon as hatched, can easily find their way to their own food, so that, in many instances, the egg is abandoned, even by the female, the moment it is dropped; and, where incubation takes place, as in the case of the spider, the first appearance of a living progeny is a signal that her task is at an end.

It is not so with birds. Their parental duties are tedious and full of labour, beginning long before the chick is produced, and continuing for a considerable time after its extrusion from the shell. They have frequently to build an artificial nest, with skill and toil, after which the eggs are to be laid and brooded on, the young are to be fed and educated. All of these operations require, some of them absolutely demand, the mutual labours of the parents. The feeding of the young, for example, might, in many instances, be impossible, without the efforts of both the male and the female. A young bird, in the nest, is exceedingly voracious, and will eagerly consume its own weight of food in a day. Where the means of procuring a daily supply for eight or ten greedy and craving mouths, is not very near or abundant, it is easy to see that the poor mother could not, with all her care, accomplish the task alone. The Creator, therefore, who placed her in these circumstances, has provided for her the means of not only lightening her labours, but rendering them delightful. Her faithful and affectionate mate constantly attends her; they build the nest together; by day, while she performs the duty of incubation, he either collects her necessary food, and care-

fully feeds her himself, or occasionally supplies her place in the nest, while she hunts the hedges and fields, to satisfy her own wants; and, when the task is accomplished, he sits on a neighbouring bough, and cheers her tedium with a song. By night, the nest is their common roosting-place, where they nestle side by side. When the callow brood are hatched, they roam, together or apart, to forage for them in the neighbouring gardens, or woods, or lawns; and, urged by parental affection, and warmed by mutual sympathy, they ply their constant toil, without remission, and without weariness. When, at length, the first helpless stage of existence is past, and the young, full-fledged, are to be committed to their own resources, the little patient and affectionate arts with which they unite to train their tender charge to the important functions of their being, gracefully crown these varied labours of love.

That reciprocal affection is the moving principle of these instincts, is not only probable, from their analogy to human sympathies, but seems to be proved by various facts, which have been observed by those who have studied their habits. On this subject, I have been much struck with a well-told and interesting anecdote, by Bingley, of a pair of tame Guinea parrots, which I feel much pleasure in transcribing.

'A male and female of this species were lodged together in a large square cage. The vessel which held their food was placed at the bottom. The male usually sat on the same perch with the female, and close beside her. Whenever one descended for food, the other always followed; and when their hunger was satisfied, they returned together to the highest perch of the cage. They passed four years together in this state of confinement; and, from their mutual attentions and satisfaction, it was evident that a strong affection for each other had been excited. At the end of this period, the female fell into a state of languor, which had every symptom of old age; her legs swelled, and knots appeared upon them, as if the disease had been of the nature of gout. It was no longer possible for her to descend and take her food, as formerly; but the male assiduously brought it to her, carrying it in his

bill, and delivering it into hers. He continued to feed her in this manner with the utmost vigilance, for four months. The infirmities of his mate, however, increased every day; and at length she became no longer able to sit upon the perch; she remained crouched at the bottom, and, from time to time, made a few useless efforts to regain the lower perch; while the male, who remained close to her, seconded these feeble attempts with all his power. Sometimes he seized with his bill the upper part of her wing, to try to draw her up to him; sometimes he took hold of her bill, and attempted to raise her up, repeating his efforts for that purpose several times. His countenance, his gestures, his continual solicitude, every thing, in short, indicated, in this affectionate bird, an ardent desire to aid the weakness of his companion, and to alleviate her sufferings. But the scene became still more interesting, when the female was at the point of expiring. Her unfortunate partner went round and round her without ceasing; he redoubled his assiduities and his tender cares; he attempted to open her bill, in order to give her nourishment; his emotion every instant increased; he went to her, and returned with the most agitated air, and with the utmost inquietude; at intervals he uttered the most plaintive cries; at other times, with his eyes fixed upon her, he preserved a sorrowful silence. His faithful companion at last expired; he languished from that time, and survived her only a few months.'*

SIXTH WEEK—WEDNESDAY.

BIRDS.—THEIR REPRODUCTIVE INSTINCTS.—PAIRING CONTINUED.

THE affectionate attention which birds show to each other during the pairing season, and in some instances continue to evince at other times, was noticed yesterday. Some other instances of this, marking peculiarities in the instinctive feeling, shall now be mentioned.

* Bingley's Animal Biography, vol. ii. p. 224.

Birds which are constant to each other, as there is reason to believe many species are, generally return to the same locality in the breeding season, and if they are not migratory, remain throughout the year in the immediate neighbourhood. 'We have, in more than one instance,' says Mr. Rennie, 'observed a pair of magpies nestle on the same tree for a series of years, where they reared a brood of four or five young ones every season All of these disappeared from the neighbourhood; at least we observed no increase in the number of nests. In one instance we observed a magpie's nest thus successively occupied for ten years.'*

It is well known, that migratory birds return year after year to the same place, each accompanied with his mate; it is not certain, however, whether or not the mate be the same individual; and, indeed, the facility with which a bird which has lost his companion can supply himself with another, throws some doubt on the subject. This facility is mentioned both by Montague and White, who have stated various facts in support of it. The following anecdote, recorded by Professor Kalm, is very striking. 'A couple of swallows built their nest in a stable, and the female had eggs in the nest, and was about to brood them. Some days afterwards the people saw the female sitting on the eggs; but the male flying about the nest, and sometimes sitting on a nail, was heard to utter a very plaintive note, which betrayed his uneasiness. On a nearer examination, the female was found dead in the nest, and the people flung her body away. The male then went to sit upon the eggs; but, after being about two hours on them, and, perhaps, finding the business too troublesome, he went out, and returned in the afternoon with another female, which sat upon the nest, and afterwards fed the young ones till they were able to provide for themselves.'

Mr. Rennie mentions some circumstances respecting the black-cap, which seem to confirm what has been stated above, and are curious in themselves. 'There has been,' says he, 'in a garden adjacent to ours, the nest of a black-cap for a

* Library of Entertaining Knowledge.—Habits of Birds, p. 74.

succession of years, and broods have been successively reared there, without any observable increase in the population of the species. Yet this bird, which is little bigger than a wren, weighing only half an ounce, has to traverse annually the whole of the south of Europe, and probably a great proportion of the north of Africa, exposed, of course, to numerous accidents, as well as to occasional scarcity of its appropriate food. From the regular annual restoration, however, of this nest at the same spot, it is obvious, that one, if not both of the black-caps, must have been wont to perform this migration to and from Africa, as safely as the more hardy cuckoo, or the more swift-winged swallow. During the spring of 1831, the black-caps, which we suppose to be the same birds, from their keeping to the same place of nestling, were more than usually late in arriving; for, in another garden, about a mile off, there were young in the hereditary nest of black-caps, before our little neighbours made their appearance from the south. When they did arrive, their attention was immediately attracted by the unusual circumstance of hearing the loud song of a rival, in the vicinity of their premises. This was a cock black-cap, which we had purchased the preceding autumn in the bird-market at Paris, and which we daily hung out in his cage, to enjoy the fresh air and the sunshine, within a gun-shot of their usual place of nestling. The wild birds did not appear to like the little stranger at all; and the cock kept flying around the cage, alternately exhibiting curiosity, fear, anger, defiance, and triumphant exultation. Sometimes he would flit from branch to branch of the nearest trees, silently peeping into the cage with the utmost eagerness; all at once, he would dart off to a great distance, as if afraid that he was about to be similarly imprisoned; on getting the better of his fears, he would perch on a conspicuous bough and snap his bill, calling *cheek, cheek*, seemingly in a great passion; again he would sing his loudest notes by way of challenge, or perhaps meaning to express his independence and superiority. Our cage-bird, meanwhile, was by no means a passive spectator of all this; and never failed, on the appearance of the

other, to give voice to his best song, and to endeavour to outsing him, since he could not get at him to engage in personal conflict.

'This sort of altercation continued for more than a week, but the wild bird began gradually to be less eager to pry into the cage, or to take any other notice of the cage-bird, and at length ceased altogether to approach it, his attention being now wholly occupied in attending to his mate, and aiding her in building their nest. It is worthy of remark, that though, on their first appearance, they resorted to the garden where the nest had hitherto been built, they finally fixed their residence in another garden, at some distance, induced, no doubt, by the vicinity of our cage-bird to their former haunts. The distance of the place to which they removed is such, that we can readily hear the song of the cock, and our bird is no less eager to answer and to endeavour to outsing him than at first; while it is worthy of remark, that the wild bird is no longer interested in such rivalry, and sings as if his only concern was to please himself and his mate.'*

Mr. Rennie is of opinion, that it was the dread of a successful rival which led the wild bird to manifest such varied expressions of passion, and hence he concludes, that, had he been removed, the hen would have readily paired with the tame bird, which is by no means improbable. But whatever there may be in this, instances of great attachment between mates are familiar, and render these little tenants of the grove peculiarly interesting.

The feeble attempt of the swallow, to supply the place of his dead mate, by brooding on the eggs, reminds me of a fact which came under my own eye, and which proves that a similar propensity sometimes exists among male birds, in a far stronger degree. One of my neighbours and parishioners had a turkey-cock and hen, which were carefully fed, and while the latter was sitting on her eggs, the former exhibited a great desire to imitate the example of his mate. He prepared a nest for himself, and sat patiently on it for several days, with-

* Library of Entertaining Knowledge.—Habits of Birds, pp. 75–77.

out eggs; and when he was chased from it, and the materials of his nest were removed, he showed great uneasiness, until he had found another situation favourable for his purpose, where he again took his seat with unshaken perseverance. At last his wishes were gratified, by being supplied with eggs, to the amount of twenty-seven, of which a few were hen eggs. The cock carefully brooded on these eggs till they were hatched, not one of them failing to be productive. To these a brood of ten chickens, brought out by a hen at the same time, was added, and he nursed the whole brood of thirty-seven without losing one. He showed, indeed, the greatest solicitude for the welfare of the young, tending them with remarkable care, and taking upon him all the duties which, in the usual course of things, fall exclusively to the mother's share. Next year, when the hen had laid her complement of eggs for a new brood, and was in the act of incubation, the cock, finding himself left alone, set himself affectionately down by the side of his mate, and could not be induced to leave her, except for necessary food. His nest was again supplied with eggs, and never did a hen fulfil her tedious weeks of incubation with greater assiduity or skill. I witnessed the fond pair on their respective nests. They were situated very near, but not in actual contact, and their faces being turned towards each other, they seemed to regard one another with a tenderness at once interesting and pleasing. This remarkable pair hatched each its own brood, and attended them as long as they required their care, with fidelity and success.

The facts I have related are the more singular, as they seem contrary to the usual instincts and habits of the turkey, especially in a wild state.* Audubon and Charles Bonaparte give an account of the wild turkeys of America, from which it appears that they only pair during the breeding season; that the cock endeavours to break the eggs of the hen, which induces her carefully to conceal her nest from him; and that,

* Pliny, however, mentions instances of cocks rearing the brood when the hen happened to die, and cases of the turkey-cock sitting on a brood have been observed by others.

at other seasons, the males and females associate and feed in companies apart, the latter and their broods carefully avoiding the haunts of the former, that they may escape fatal consequences from their hostility to their young. It is singular to observe this change of instinct, arising from altered circumstances. The absence of a rival probably contributed to give so different a character to the manners of the cock I have mentioned.

The pairing instincts now detailed, are not without considerable exceptions, among which, one of the most remarkable, is the polygamous habits of most birds. Of this kind, we have a well-known example in the domestic cock; but, as my plan leads me rather to draw a sketch than write a history, what I have already said on this subject may suffice. The reader will not fail to recognize, even in these hasty details, unequivocal traces of Divine skill, of which here, as in every other department of Nature, the whole works of the Creator are full.

SIXTH WEEK—THURSDAY.

REPRODUCTION OF BIRDS.—NEST-BUILDING.

The first care of birds, after pairing, is to discover a fit place for preparing their nests; and, in doing this, their instincts, which are uniform in the species, direct them with admirable tact to the locality best suited for their own peculiar habits and temperament, as well as for the purposes of concealment from their enemies, or at least of safety from their attacks. If there are exceptions from this rule, they are such as serve only to confirm it, by showing more clearly its nature and beneficent object. The ostrich, for example, which resides in the desert wilds of Africa, apart from the habitations of her enemy man, and also, in general, from any animal likely to annoy, which can cope with her in strength, lays her eggs in a nest carelessly chosen, and very inartificially formed, in the

bare sand; but then, these nests are never deserted, for the male alternates the act of incubation with the female. The eagle builds his eyrie among the almost inaccessible rocks of the lofty mountains, open to the atmosphere, but secure. The smaller birds, whether they construct their nests among the long grass of the meadow, the bush or brake of the woodlands, the leafy hedge or lofty bough, or whether they seek the dwellings of the human race, and nestle in the window-corner, in the eaves of the thatched roof, or in the shelter of some deserted chimney, uniformly display a consummate skill in acting on the principle I have stated, so far as is consistent with other circumstances in their condition and habits.

But what is still more worthy of remark, is the degree of care with which the nest itself is constructed, which remarkably corresponds with the necessity of the case. I have mentioned the carelessness with which the eagle and the ostrich prepare their nests; and this inattentive habit is common to almost all the larger birds, while, in proportion as the size of the bird diminishes, the skill with which the materials of the nest are selected and interwoven is in general increased. The intention of this is not doubtful. The chief object of careful nest-building, is the preservation of an equable heat in the eggs; but when the fowl happens to be large in proportion to the size or number of the eggs, or when the temperature of the climate is warm, the natural heat of the body is sufficient for all the purposes of incubation; and it is only when this circumstance is reversed, as is the case in the smaller birds, or in such as build in a cold climate, or early in spring, that any artificial means are necessary. There is here, then, a remarkable accommodation to circumstances—a wisdom altogether beyond that of the bird itself, and referable, like other instincts, only to the Creator. Who taught those early breeders, the blackbird and the thrush, to plaster their nests with loam, that they may exclude the keen icy gales of the still lingering winter? Who taught the eider-duck, in the chilly regions of Iceland, to tear the down from her body, that by a lining so soft and warm, she may protect her precious

charge from the inclemency of that climate? Who taught that hardy little warbler, the golden-crested wren, which fears no cold for itself, and which delays its maternal labours till the middle of summer, to compensate for the trifling degree of warmth communicated from its tiny form, by building its beautiful nest, of the warm and velvet moss, interwoven with the spider's web, and filled with such a profusion of feathers, that its little eggs, by the retention and accumulation of the heat, are kept in a temperature at once high and equable? And, on the other hand, who taught the emu, the osprey, and the condor, to know that their comparatively gigantic bodies were sufficient of themselves, without the aid of an artfully formed nest, to impart the requisite warmth for the vivifying of their eggs, small as they are in number, and large in bulk?* Who, indeed, we may ask, taught any of the winged tribes that the heat of their bodies was necessary for the development of the embryo in the egg? The whole subject is full of wonder and instruction, and calculated to overwhelm the mind with devout admiration. 'Who knoweth not, in all these, that the hand of the Lord hath wrought this?'

Another circumstance which I may mention, is the remarkable variety observable in the habits of birds in nest-building, where the instinct itself is so peculiar, and its general principle so identical. The same form of the nest, and place of building, and materials employed, are rarely, if ever, found united in the architecture of different species; and, indeed,

* It must be confessed, however, that although what has been said in the text is true as a general law, there are many instances for which it may be difficult to account on the same principle, though, doubtless, even these cases, were we acquainted with all the circumstances, would be equal indications of wise adaptation. The wood-pigeon and the jay, for example, though they erect their fabrics on the tall underwood, in the open air, construct them so slightly, and with such a scanty provision of materials, that they seem scarcely to make sufficient provision for the supply of the brood, and even their eggs may almost be seen through the loosely connected materials. Is it, that there is something in the constitution of the eggs, which makes them less susceptible than others of the alternation of heat and cold?

in every one of these particulars, there is generally some specific difference. The house-sparrow builds four or five times in the year, in a variety of situations, under the warm eaves of our houses and sheds, the branch of a clustered fir, or the thick tall hedge which bounds our garden, employing, in all these situations, a mass of straw and hay, and for a lining, feathers from the poultry-yard. The goldfinch forms the cradle of its young with fine mosses and lichens, collected from the apple or pear-tree, compact as felt, lining it with the thistle-down,—a model of beautiful construction. A few loose bents and goose-grass, on the other hand, rudely entwined, with perhaps a sprinkling of hair, suffice for the midsummer nests of the whitethroat and blackcap. The greenfinch builds carelessly in the hedge, with materials of the coarsest kind; while the chaffinch constructs its anxiously-concealed edifice with the nicest art, in the neighbouring beech or elm. The bullfinch requires fine roots for its nest; the grey fly-catcher chooses cobwebs for the out-works of its building.* It seems as if Providence had intended that all kinds of portable materials, adapted for the purpose, should be put in requisition by this variety of choice in the different families, so that nothing might be lost, and that one species might not inconveniently interfere with another.

'It wins my admiration
To view the structure of that little work—
A bird's nest. Mark it well, within, without;—
No tool had he that wrought; no knife to cut;
No nail to fix; no bodkin to insert;
No glue to join; his little beak was all;
And yet, how neatly finished! What nice hand,
With every implement and means of art,
And twenty years' apprenticeship to boot,
Could make me such another? Fondly, then,
We boast of excellence, whose noblest skill
Instinctive genius shames.'—HURDIS.

* Journal of a Naturalist.

SIXTH WEEK—FRIDAY.

REPRODUCTION OF BIRDS.—NEST-BUILDING CONTINUED.

In yesterday's paper, having made some general observations relative to the instincts connected with nest-building, I shall, to-day, select a few instances of peculiarity in this species of architecture, which may serve to illustrate these remarks.

I begin with the eagle, which has justly been termed the king of birds. Her nest is usually built, as I have already observed, in some inaccessible cliff of a rock; sometimes shielded from the weather by an overhanging crag, but sometimes also exposed both to the wind and rain. It is flat, though built with considerable labour, and the pains bestowed in erecting it seem only once to be encountered, as she is said to make it her breeding-station for life. Willoughby thus describes a nest which was found on the Peak of Derby:—'It was made of great sticks, resting one end on the edge of a rock, the other on two birch trees. Upon these was a layer of rushes, and over them a layer of heath, and upon the heath rushes again; upon which lay one young one, and an addle egg; and, by them, a lamb, a hare, and three heath plants. The nest was about two yards square, and had no hollow in it. The young eagle was of the shape of a goshawk, of almost the weight of a goose, rough-footed, or feathered down to the foot, having a white ring about the tail.'

The circumstance mentioned of the addle egg, seems to be very common among all the eagle tribes, owing, perhaps, to the flatness of the nest; and, it may be regarded as indicating the same providential intention as that already alluded to in regard to the fewness of their eggs. The design is, that this devourer of the more helpless of the quadruped tribes, should be preserved and propagated in sufficient abundance to perform its office of keeping these prolific species within their proper bounds, but should, at the same time, be prevented from itself becoming a pest by over production.

The woodpecker is another bird whose nest is an object of curiosity and admiration, though for a very different reason. This numerous tribe have very remarkable habits in procuring their food: and the instruments with which they are endowed, are admirably fitted to the peculiarity of their condition, which consists in feeding on insects lodged in the interior of decaying trees. These I must not stop at present to describe; but I have to observe that its bill, which is so beautifully contrived for procuring its subsistence, serves also, in this country, to enable it to scoop out for itself a nest, which it does with all the neatness of an experienced workman, in one of the trees where it finds its food. The work is thus graphically described by Wilson:—'About the middle of May, the male and female look out for a suitable place for the reception of their eggs and young. An apple, pear, or cherry-tree, often in the near neighbourhood of a farm-house, is generally pitched upon for this purpose. The tree is minutely reconnoitred for several days previous to the operation; and the work is first begun by the male, who cuts out a hole in the solid wood, as circular as if described by a pair of compasses. He is occasionally relieved by the female,—both parties working with the most indefatigable diligence. The direction of the hole, if made in the body of the tree, is generally downwards, by an angle of thirty or forty degrees, for the distance of six or eight inches, and then straight down, for ten or twelve more, —within, roomy, capacious, and as smooth as if polished by the cabinet-maker; but the entrance is judiciously left just so large as to admit the bodies of the owners. During this labour, they regularly carry out the chips, often strewing them at a distance, to prevent suspicion. This operation sometimes occupies the chief part of the week.'

This labour is sufficiently curious; but what is far more worthy of attention, is the total change of instinct in birds of the same species, under other circumstances. There is not, indeed, in the whole history of Nature, a more singular instance of sagacity, if it can be called by that name, than what is displayed by these little winged wonders, in protecting

themselves against their enemies. In civilized countries, man is the chief foe they have to dread; and the nest we have described suffices for their protection from him. But the case is different in the wide-spread forests of America. In the depth of these wildernesses, where little is to be apprehended from man, it is not concealment that is necessary, but a situation beyond the reach of those rapacious creatures which infest the woods, and live by plunder. From the monkey and the snake, which are in these regions the natural enemies of the woodpecker, its European nest would be no security. It must select a place which these insidious foes may, indeed, observe, but cannot invade. This, with admirable skill, it accomplishes, by building its nest depending from the most outward branches of a tall tree, such as the banana or the plantain. 'On one of these immense trees,' says Goldsmith, 'is seen the most various and the most inimical assemblage of creatures, that can be imagined. The top is inhabited by monkeys of some particular tribe, that drive off all others; lower down, twine about the great trunk, numbers of the larger snakes, patiently waiting till some unwary animal come within the sphere of their activity; and, at the edges of this tree, hang those artificial nests, in great abundance, inhabited by birds of the most delightful plumage.'

The nest is usually formed in this manner:—When the time of incubation approaches, the woodpeckers fly busily about, in quest of a kind of moss, called, by the English inhabitants of those countries, *old-man's-beard*. It is a fibrous substance, which bears to be moulded into any form, and glued together. This the little bird first fixes, by some viscous substance, gathered in the forest, to the most extreme branch of a tree; then, building downwards, and still adding fresh materials to those already procured, it forms a nest, which hangs, like a pouch, from the point of the branch. The hole to enter at is on the side; and all the interior parts are lined with the finer fibres of the same substance, which compose the rest of the fabric.

Such is the ingenious and effectual contrivance, by which

the American woodpeckers, as well as some other birds who have the same enemies to dread, save themselves and their young from the depredations of the serpent and the monkey. The nest hangs there, before the spoilers, a tempting object, which they can only gaze upon, while the bird flies in and out, without danger or molestation.

This instinct is common to many tribes of birds. Some form their pensile nests in the shape of a purse, deep and open at the top; others with a hole in the side; and others, still more cautious, with an entrance at the very bottom. But of them all, the tailor-bird shows the greatest diffidence, advancing a step farther for safety, by fixing its light nest on a leaf. It picks up a dead leaf, and actually sews it to the side of a living one, its slender bill being its needle, its thread some fine fibres, and the lining, feathers, gossamer, and down. Its weight is only three-sixteenths of an ounce, so that, with the addition of its tiny eggs, and of the light materials of its nest, the leaf is still sufficient for its support.

I shall conclude this paper with an account of a magpie's nest, by the Rev. John Hall, which exhibits ingenuity of a different kind, and by its peculiar adaptation to the circumstances of a single locality, seems to indicate a power of contrivance more allied to reason than to instinct. 'On the road between Huntly and Portsoy,' says he, 'I observed two magpies, hopping round a gooseberry bush, in a small garden, near a poor-looking house, in a peculiar manner, and flying out and into the bush. I stepped aside to see what they were doing, and found, from the poor man and his wife, that these magpies, several succeeding years, had built their nest, and brought up their young in this bush; and, that the foxes, cats, hawks, &c., might not interrupt them, they had not only barricaded their nest, but had encircled the bush with briers and thorns, in a formidable manner, nay, so completely, that it would have cost even a fox, cunning as he is, some days labour to get into the nest.

'The materials in the inside of the nest were soft, warm, and comfortable; but all on the outside so rough, so strong,

and firmly entwined with the bush, that, without a hedge-knife, hatch-bill, or something of the kind, even a man could not, unless with much pain and trouble, get at their young; for the distance from the outside to the inside of the nests extended as long as my arm.

'These magpies had been faithful to one another for several summers, and had driven off their young, as well as every one else that attempted to take possession of their nest. This they carefully repaired and fortified in the spring, with strong, rough, prickly sticks, that they sometimes brought, by uniting their force, one at each end, pulling it along, when they were not able to lift it from the ground.'*

SIXTH WEEK—SATURDAY.

REPRODUCTION OF BIRDS.—NEST-BUILDING CONTINUED.—THE GROSSBEAK—THE HUMMING-BIRD.

One of the most peculiar modes of structure to be found among the feathered tribes, is that which distinguishes the *sociable* grossbeak, a particular family of the species, which is so named from its mode of building in societies. Birds of the same species inhabit the pine forests of Europe, Asia, Africa, and North America, and are also to be found in the woods of the north of Scotland. The following account of the architecture of these birds is given in Vaillant's Travels:—

'I observed in the way, a tree, with an enormous nest of these birds, to which I have given the appellation of republicans; and, as soon as I arrived at my camp, I despatched a few men with a waggon to bring it to me, that I might open the hive, and examine its structure in its minutest parts. When it arrived, I cut it to pieces with a hatchet, and saw that the chief portion of the structure consisted of a mass of Boshman's grass, without any mixture, but so compact and

* Travels in Scotland.

firmly basketed together, as to be impenetrable to the rain. This is the commencement of the structure, and each bird builds its particular nest under this canopy. But the nests are formed only beneath the eaves of the canopy, the upper surface remaining void, without, however, being useless; for, as it has a projecting rim, and is a little inclined, it serves to let the rain water run off, and preserves each little dwelling from the rain. Figure to yourself a huge, irregular, sloping roof, all the eaves of which are completely covered with nests, crowded one against another, and you will have a tolerably accurate idea of these singular edifices.

'Each individual nest is three or four inches in diameter, which is sufficient for the bird; but as they are all in contact with one another around the eaves, they appear to form but one building, and are distinguishable from each other only by a little external hole, which serves as an opening to the nest, and even this is sometimes common to three different nests, one of which is situated at the bottom, and the other two at the sides.

'The large nest that I examined, was one of the most considerable I had any where seen in the course of my journey, and contained three hundred and twenty inhabited cells, which, supposing a male and female to each, would form a society of six hundred and forty individuals. Such a calculation, however, would not be exact. I have spoken above of birds, in which one male is common to several females, because the females are much more numerous than the males. The same is the case with many other species, both in the environs of the Cape, and in the colony, but it is particularly so among the republicans. Whenever I have fired at a flock of these birds, I have always shot four times as many females as males.'

The smallest, as well as one of the most interesting and beautiful of the feathered tribe, is the humming-bird, a native of America. Of this little creature there are six or seven varieties, from the size of a small wren down to that of an humble bee. It is easy to imagine how much these tiny

flutterers must add to the beauty of a rich western landscape. As soon as the sun is risen, the humming-birds of different kinds are seen fluttering about the flowers, without ever lighting upon them, in search of the insect food on which they subsist. Their wings are in such rapid motion as to make the humming sound from which they derive their name, and it is impossible to discern their colours, except by their glittering. The nests of a species, which seems to form the link in the chain that unites the feathered with the insect tribes, deserve to be noticed. Goldsmith describes them as 'suspended in the air at the point of the twigs of an orange, a pomegranate, or a citron-tree; sometimes even in houses, if they find a small and convenient twig for the purpose. The female is said to be the architect, while the male goes in quest of materials, such as cotton, fine moss, and the fibres of vegetables. Of these materials, a nest is composed of about the size of a hen's egg cut in two.

Mr. Wilson gives the following description of the nidification of the ruby-throated humming-bird. 'In Pennsylvania, the humming-bird usually arrives about the 25th of April,* and about the 10th of May begins to build its nest. This is generally fixed on the upper side of a horizontal branch, not among the twigs, but on the body of the branch itself. Yet I have known instances where it was attached, by the side, to an old moss-grown trunk; and others, where it was fastened on a strong rank stalk or weed in the garden; but these cases are rare. In the woods, it very often chooses a white oak sapling to build on, and in the orchard or garden selects a pear tree for that purpose. The branch is seldom more than ten feet from the ground. The nest is about an inch in diameter, and about as much in depth. A very complete one is now lying before me, and the materials of which it is composed are as follow:—The outward coat is formed of small pieces of a species of bluish grey lichen, that vegetates on old trees and fences, thickly glued on with the saliva of the bird, giving firmness and consistency to the whole, as well as keeping

* The humming-bird is migratory from one part of America to another.

out moisture. Within this are thick matted layers of the fine wings of certain flying seeds, closely laid together; and lastly, the downy substance from the green mullien, and from the stalks of the common fern, lines the whole. The base of the nest is continued round the stem of the branch, to which it closely adheres; and, when viewed from below, appears a mere mossy knot, or accidental protuberance. The eggs are two, pure white, and of equal thickness at both ends. On a person's approaching the nest, the little proprietors dart around with a humming noise, passing frequently within a few inches of one's head, and should the young be newly hatched, the female will resume her place on the nest, even while you stand within a yard or two of the spot.'

I cannot resist the pleasure of continuing Mr. Wilson's narrative of this delightful little tenant of the air. 'The humming bird is extremely fond of tubular flowers, and I have often stopped with pleasure to observe his manœuvres among the blossoms of the trumpet-flower. When arrived before a thicket of these that are full blown, he poises or suspends himself on wing, for the space of two or three seconds, so steadily, that his wings become invisible, or only like a mist, and you can plainly distinguish the pupil of his eye, looking round with great quickness and circumspection; the glossy golden green of his back, and the fire of his throat, dazzling in the sun, form altogether a most interesting appearance. When he alights, which is frequently, he always prefers the small dead twigs of a tree or bush, where he dresses and arranges his plumage with great dexterity. His only note is a single chirp, not louder than that of a small cricket or grasshopper, generally uttered when passing from flower to flower, or while engaged in fights with his fellows; for when two males meet at the same bush or flower, a battle instantly takes place; and the combatants ascend in the air, chirping, darting, and circling round each other, till the eye is no longer able to follow them. The conqueror, however, generally returns to the place to reap the fruits of his victory. I have seen him attack, and for a few moments tease the king-bird, and have

also seen him, in his turn, assaulted by the humble bee, which he soon put to flight. He is one of those few birds that are universally beloved, and amidst the sweet dewy scenery of a summer morning, his appearance among the arbours of honeysuckles, and beds of flowers, is truly interesting.'

'When morning dawns, and the blest sun again
Lifts his red glories from the western main,
Then through our woodbines, wet with glittering dews,
The flower-fed humming-bird his round pursues;—
Sips, with inserted tube, the honey'd blooms,
And chirps his gratitude as round he roams;
While richest roses, though in crimson drest,
Shrink from the splendour of his gorgeous breast.—
What heavenly tints in mingling radiance fly!
Each rapid movement gives a different dye;
Like scales of burnish'd gold, that dazzling show,
Now sink to shade,—now like a furnace glow.'

SEVENTH WEEK—SUNDAY.

ON THE DOMESTIC AFFECTIONS.

Our admiration is called for continually, in observing those adaptations which are visible to the eye, and the multitude more which are revealed by the telescope; and, in our feeble degree, we apprehend them, and say 'they are all very good.' But there are invisible, and moral, and mental adaptations, of equal power, and of more deep and permanent influence, the absence of which would alter the whole character of the world, nay, would tear up by the roots the whole system of things. We have been invited to rejoice that the prevailing colour of the earth is not scarlet, which would wound the sight, but green, which refreshes it;—that the liquid which slakes the thirsty creation is of crystalline purity, instead of a turbid mass of atoms, and that its perfect insipidity enables

man to mingle it with every thing, without conveying a wearisome sameness of flavour;—that to satisfy the appetites necessary to sustain our frames, is gratifying, instead of painful, distressing, or disgusting. These, and a thousand other adaptations, we own, with admiring gratitude, to be the work of beneficence, unbounded as its ingenuity is inexhaustible. But from these, I conceive, we rise to a higher station, when our attention is fixed on the machinery of loves and hatreds, by which the moral world is governed, and to which the feebleness of youth, and the infirmity of old age, alike owe their support. Notwithstanding the calamity which plunged man from his holy state of love unmingled with selfishness, and of benevolence unexcited by suffering, into a condition where self-love is necessary, in part, to self-preservation, and where affection is not trusted to spontaneous emotion, but is excited, nay, even demanded, to counteract a constant tendency to suffering,—notwithstanding this disordered state of things, love of others is the ruling principle of the world; and it is impossible that it should be otherwise, so long as the God of love continues to govern it. The earliest springs of life are linked with love. The very brutes seem, in their maternal capacity, to arise to something of moral beauty, and intelligent sentiment. What lover of Nature has not traced a gleam of benevolence in the poor ass, when giving nourishment to, or observing the gambols of, her young one, who exhibits, in his kind, marks of infantine beauty and fondness? Who that has observed the complacent and benign countenance of the lioness, when nourishing her cubs in her cage, but has wondered to see the ferocity of the beast of the forest swallowed up in parental love? Who that has read of the wounded Polar bear, fleeing from the ice-bound ship, yet stopping, in the midst of her agony, to lift first one of her young ones, and then the other, and fling it, as far as her strength would allow, out of the reach of her pursuers, has not felt his heart swell in sympathy with the afflicted monster? Was there not that in her love and care, in the midst of her own mortal agony, which elevated the shaggy beast to the verge of human emo-

tion? Has not even the heart of the rough backwoodsman smitten him, when his skilful imitation of the cry of a wounded fawn has made the ever-watchful and tender doe start into his view, within the range of his gun?

But, rising above these tokens of affection amongst the beasts, which, from their brief duration, have been by man estimated as only on the level of instincts, let us examine affection as it operates in the human being, securing not only the production, but the tender preservation and rearing of offspring, in spite of all obstacles and difficulties. How often may the parents be observed, whose more tender and refined feelings have lain always uncultivated, or have been repressed and subdued, as if too delicate a type for the rude soil of poverty and privation, who are yet, in the parental character, exercising self-denial and hard exertion. The virtuous day-labourer, living more abstemiously, that he may bestow the blessing of teaching and of school-books on his children; and the careful mother, consuming not the day only, but a portion of the hours of the night, in repairing and fitting out her children, that they may go to school or to work, are sights with which Scotland is happily familiar. These are the actions which meet the eye, but the spring of the actions is beyond human sight; it is with the God who planted love in the heart, and who is himself the fountain of love. He hath set the solitary in families; and has so formed even his fallen creatures, that the first emotions called into action, are emotions of benevolence. Have we not seen the mother, whose only home is the wretched cloak which hangs on her, press even the child of her shame and sorrow to her forlorn breast, —poor in every thing, save in maternal tenderness? Have we not seen the miserable child look up and smile, and, kindling at her eye, learn to love in return? Place such an one, with the babe who consumes her scanty sustenance in one arm, and the basket which contains her slender merchandise in the other, in a position of danger, and force her to choose which she will sacrifice,—her 'bread winner' or her babe. The selection will be the work of a moment. Her babe will

be clasped the closer to her bosom, and the wares, on which their livelihood depends, flung away; and this, not upon a process of reasoning concerning the comparative worth of the objects, or the comparative guilt of sacrificing the human being; but upon the powerful and predominant feeling that she loves her babe, and, rather than part with it, would run the risk of their starving together.

The Author of our being might, if actuated by malevolence, have bound us together by the iron fetters of necessity, even under the influence of hatred and animosity. We can suppose nothing else required to exhibit the condition of ceaseless woe, than families forced to dwell together, and to lend each other all the mutual aids now lent, but through a medium of aversion and disgust. To reduce the domestic affections to indifference, would rob this world of all its sunshine; and, if it spared to mourners the pangs of separation, would also deprive them of all the lights of life. But to turn affection into aversion, and love into hate, would render this world worse than a den of dragons. We can never trace how much of the minor and collateral affections spring from those first throbbings of the heart, that exist between parent and child. It is remembered even of the poor spendthrift, who has rendered himself disgusting and disgraceful to humanity, that he had parents,—that once he loved and was beloved, and some heart is still found to regard him with pity. The friendless, unconnected man, who lies waiting for his dismissal in the corner of the work-house, and whose dismissal is perhaps thought tardy in its approach by the parish officers, will yet find in the nurse of the place some stirrings of humanity; for she, too, has cherished her offspring, and he had a mother once!

Unseen, but blessed links, which twine themselves through all the ties of life! Ye are the gift of God, and your tendency is to re-aspire to him. It has been remarked by a philosopher, more curious than profound, that the very haste which hatred makes, the very misery that revenge endures till it is satisfied,—arises from the keen desire which the heart

feels to rid itself of so unwelcome a guest as animosity. Some of my readers may still remember the pleasure with which they hung on the lips of our great moral philosopher, when he, with a deeper view of his subject, said, 'Who made benevolence pleasant? was it not the Benevolent? And who made malevolence painful? was it not still the Benevolent?'*

We draw love from our mother's breast, and from the eye of our father. Love rocks us in our cradle, and beams on us in our little brothers and sisters. Ah! what a family of love had this world contained, if sin had not introduced hate, and destroyed the scene of joy. But love can restore it,—nay, love gives itself no rest till it be restored. The God who has formed the paternal affections, offers himself as our Father, not only in his character of Creator, but in the far more costly and more endearing character of Redeemer. Love contrived the plan of our rescue. Love executed it. Love urges it upon us. Love waits to bestow it.—We are dull and slow. Hark! he hastens us. 'Return unto me, and I will return unto you, saith the Lord.' 'Ye shall be mine in the day that I make up my jewels.' 'I hate putting away.' 'I will heal your backslidings, I will receive you graciously, and love you freely.' Reader, will you not try to aspire after this noble adoption,—to obtain this new and filial attachment? With this new element in your nature, your heart will become enriched by emotions to which it is now a stranger,—cleared of pangs which now harass and torment it,—and inspired by hopes which the reality will far surpass. Look then to Jesus, and, through him, to your reconciled Father; and then shall you know of a truth what it is to be loved, protected, guided, and provided for, by Parental Affection.

M. G. L. D.

* Dugald Stewart.

SEVENTH WEEK—MONDAY.

REPRODUCTION OF BIRDS.—NESTS OF SWALLOWS.

I SHALL close this selected account of nidification, by a short detail of the various peculiarities in the nest-building of the swallow tribe, one of the most remarkable, and generally favoured by man, of the winged race. 'The swallow,' says Sir H. Davy, 'is one of my favourite birds, and a rival to the nightingale; for he glads my sense of seeing as the other does my sense of hearing. He is the joyous prophet of the year, the harbinger of the best season. He lives a life of enjoyment amongst the loveliest forms of nature; winter is unknown to him, and he leaves the green meadows of England in autumn, for the myrtle and orange groves of Italy, and for the palms of Africa.' The same sentiment is poetically expressed by Anacreon:—

> 'Gentle bird, we find thee here!
> When Nature wears her summer vest,
> Thou comest to weave thy simple nest;
> And when the chilling winter lowers,
> Again thou seek'st the genial bowers
> Of Memphis, or the shores of Nile,
> Where sunny hours of verdure smile.'

Early in the spring, when the gnat and the beetle put off their earthly robes, and venture into the air, the swallow is seen returning to the British shore, from its long migration; but it does not begin to build till the sun has acquired more power, and the increasing numbers of the insect tribes promise a plentiful supply of food for its future progeny. The nest is constructed with great art, with mud carried in its bill from some neighbouring brook, well tempered, and moistened with water. It is kept firm by long grass and fibres of various plants; within, it is lined with feathers, those of the goose being preferred from their warmth, and the neatness with which they admit of being packed. There are three kinds

common to this country,—the chimney swallow; the window swallow, or martin; the sandy-bank swallow, or sand-martin. The first of these leaves its nest open at the top, the two last take care to secure theirs with some kind of covering. Wilson gives some interesting details of the building habits of these birds in America, where they differ from our swallows in various particulars, as well as in colour, which is of a bright chestnut on the belly, where ours is pure white. 'Early in May,' says he, 'they begin to build. From the size and structure of the nest, it is nearly a week before it is completely finished. One of these nests, taken on the 21st of June from the rafter to which it was closely attached, is now lying before me. It is in the form of an inverted cone, with a perpendicular section cut off on that side by which it adhered to the wood. At the top it has an extension of the edge, or offset, for the male or female to sit on occasionally. The upper diameter is about six inches by five, the height externally seven inches. The shell is formed with mud, mixed with fine hay as plasterers do their mortar with hair, to make it adhere the better. The hollow of this cone is filled with fine hay, well stuffed in; above that is laid a handful of very large downy goose-feathers. Though it is not uncommon for twenty and even thirty pairs to build in the same barn, yet every thing seems to be conducted with great order and affection.'

The window swallow, whose nest is too familiar to my readers to need any special description, is remarkable for occasionally selecting singular situations for its place of incubation, and for the tenacity with which it adheres to its choice when it has once completed the building. M. Hebert mentions a pair which built on the spring of a bell; and says that, though the concussion, when the bell was rung, prevented the young from being hatched, they continued to inhabit the insecure nest for the rest of the season. Another pair mentioned by Bingley, built for two successive seasons on a pair of garden-shears, stuck up against the boards in an out-house; and another still, attached their tenement to the

wings and body of a dead owl, hung up on the rafter of a barn, and so loose as to be moved by every gust of wind. This last was placed as a curiosity in the Leverian Museum.

Shakspeare, in his own characteristic style, has described the peculiar habits of this agreeable little bird :—

> 'This guest of summer,
> The temple-haunting martlet, does approve
> By his loved masonry, that heaven's breath
> Swells wooingly here; no jetty, frieze, buttress,
> Nor coigne of vantage, but this bird hath made
> His pendant bed and procreant cradle; where they
> Most breed and haunt, I have observed the air
> Is delicate.' MACBETH.

The singular method which the house-martin sometimes takes to revenge itself on a sparrow when it endeavours to avail itself, as it not unfrequently does, of the labours of this ingenious architect, by taking forcible possession of its habitation, has been noticed by several writers. The following instance has been detailed to me by a friend, who was an eye-witness to the whole transaction :—At Millfieldhill, in Northumberland, two pairs of swallows were accustomed to rebuild their hereditary nests, one at each upper corner of a bedroom window. One year, after the little 'clay-built sheds' were just completed, a sparrow thought proper to ensconce herself in one of them. Immediately the outraged pair began to twitter with a loud and irritated note, and darting frequently in at the door of the nest, endeavoured to dislodge the intruder. But in vain. The sparrow, protected as behind a battery, sat with her bill, a formidable weapon of defence, in the middle of the entrance, and gave so warm a reception to the besiegers, that, after a long and fierce contest, the lawful owners were obliged to yield to the fraudulent occupier; but not unrevenged. They retired for a time, along with their neighbours of the opposite corner, as if for consultation, and by-and-by were seen returning in a band, apparently to renew the struggle with these fresh auxiliaries. —But no such thing; each was loaded with a mouthful of

clay, and, setting diligently to work, adhering by their claws to the outside of the nest, they had, before nightfall, completed their ingenious object of retaliation, by entirely building up the entrance to the nest, and thus leaving the robber sparrow a helpless captive, immured in a prison, where she had hoped to secure for herself a commodious habitation. Here the sparrow remained closely pent up till next morning, when a maid-servant, taking pity on the prisoner, restored her to liberty, by drawing down the upper sash of the window. This operation, however, destroyed the structures of both the friendly pairs; but, nothing discouraged, they immediately recommenced their laborious task, and, in a few days, had re-erected them on the same site. We may well inquire if it was simple instinct which led to this combination and ingenious device. And if so, our next inquiry will be, how this kind of instinct is to be defined, so as to distinguish its operations from those of reason.

There is a species of swallow called *Salanguano*, which inhabits Java, and other islands of the Indian Archipelago, whose nests are of a very remarkable construction; and, being edible, and highly esteemed by Chinese epicures, form a valuable article of commerce. They differ considerably in their composition; and the manner of procuring their materials, and constructing them, is more a matter of conjecture than of certainty. Some authors, among whom is Goldsmith, assert that the substance of these nests is a sort of froth of the sea, or of the spawn of fish, which is alleged to be strongly aromatic; some describe it as a kind of gum, collected by the birds from the tree called *Calambone;* others, again, would have us to believe, that it is a viscous humour, discharged by them through the bill at the season of reproduction. Whatever this singular substance may be, it is deposited by the swallows in deep caverns, frequently very dangerous of access, yet where human cupidity and epicurism have found means to penetrate. 'The most remarkable and productive caves in Java,' says Mr. Crawford, 'of which I superintended a moiety of the collection for several years, are those of Karan-

bolang, in the province of Baglen, on the south coast of the island. There the caves are only to be approached by a perpendicular descent of many hundred feet, by ladders of bamboo and ratan, over a sea rolling violently against the rocks. When the mouth of the cavern is attained, the perilous office of taking the nests must often be performed by torch-light, by penetrating into recesses of the rock, where the slightest trip would be instantly fatal to the adventurers, who see nothing below them but the turbulent surf, making its way into the chasms of the rocks. The common prices for these nests at Canton, are, for the most esteemed kinds, about six pounds sterling per pound weight, while the inferior sorts scarcely average more than half of that enormous sum. From Java there are exported about 27,000 lbs., the greater part of which is of the first quality. From the Saluk Archipelagoes, between two and three times that quantity is exported. It is computed, that 30,000 tons of Chinese shipping is employed in this extraordinary trade; and that the whole yearly quantity consumed is not less than 242,400 lbs. In the Indian Archipelago, at the prices already quoted, this property is worth 1,263,519 Spanish dollars, or £284,290. It forms a considerable branch of the revenues of the Crown.'

I cannot close this sketch of the various modifications of that instinct with which it has pleased the Creator to endow the winged tribes, without again soliciting attention to the variety and wisdom of the contrivances by which the safety, both of the parents and their progeny, is provided for, regarding, as they do, not merely the peculiar habits of the birds themselves, and the susceptibility of injury in their eggs and young, but their particular locality with reference to climate, and to the living creatures which exist in their neighbourhood. I have already noticed a remarkable instance of this latter kind of adaptation, in the different kinds of nests formed by the woodpeckers of Europe and of America; and I think the reader will join me in a similar observation with regard to the swallows of India, as compared with their congeners in our own quarter of the world. Here this tribe

are strikingly familiar with their fellow inhabitants of the human race. There is nothing in the materials of their nests which man can covet, and they therefore freely throw themselves on the protection of that lord of the creation. But it is very different in the Indian Archipelago. There, from some peculiarity with which we are not acquainted, the swallows are made to build their 'procreant cradles' of materials which man eagerly covets as food; and, therefore, these little tenants of the air are taught to retire to deep and dangerous caverns, which their wings enable them easily to penetrate; but where nothing but a morbid and pampered appetite could induce man to pursue them.

SEVENTH WEEK—TUESDAY.

REPRODUCTION OF BIRDS.—HATCHING OF EGGS, AND REARING THE BROOD

When the nest is prepared, the bird is instructed, by Him who has so mysteriously provided for the propagation of the mortal beings he has created, to lay that number of eggs which she can safely rear, or which, in his infinite wisdom, he finds best calculated for preserving the balance of living beings. I have already observed, that there is in this, as in other departments of Nature, a distinct evidence of beneficent contrivance in the general law which regulates the number of eggs hatched by each species—inasmuch as, that birds of prey, which are intended to restrain within certain bounds, but not to exterminate, the smaller tribes, produce very few; while the other orders, in proportion to their helplessness and liability to destruction, produce a more numerous progeny. It is curious to observe the instinct which regulates this. The bird, by its natural constitution, is capable of laying many more eggs than she actually produces in one season; but, as soon as she finds her nest sufficiently replenished, she desists from laying, of her own accord, and by an apparently

voluntary act. The domestic fowl is a familiar example of this. Although she is capable of producing eggs through the greater part of the year, yet, if her nest be left undisturbed, she will refrain from laying, and begin to brood, as soon as she finds that she has laid as many as the heat of her body can easily warm. That this is the case with wild birds also, I remember having myself, when a school-boy, proved by an experiment. Having found the nest of a yellow-hammer—a bird for which school-boys have no tenderness—I carefully abstracted one of the three eggs which it contained, when the bird did not appear to be within observation, and, next day, was delighted to find another laid in its stead. This also I abstracted; and, day after day, I continued to do the same thing, till I was in possession of fifteen eggs. The bird then deserted her nest, having laid three times the number of eggs she would have done had I not been guilty of this somewhat cruel depredation.

The anxious care and patient endurance, with which the duty of incubation is performed, is worthy of the highest admiration. 'Nothing,' says Goldsmith, 'can exceed the patience of birds while hatching; neither the calls of hunger, nor the near approach of danger, can drive them from their nest. They are often fat when beginning to sit, yet, before incubation is over, the female is usually wasted to skin and bone.' Addison, in his own elegant language, thus speaks of the instinct of the domestic fowl:—'With what caution does the hen provide herself with a nest in places unfrequented, and free from noise and disturbance! When she has laid her eggs in such a manner, that she can cover them, what care does she take in turning them frequently, that all parts may partake of the vital warmth! When she leaves them, to provide for her necessary subsistence, how punctually does she return, before they have time to cool, and become incapable of producing an animal! In summer, you see her giving herself greater freedoms, and quitting her care for above two hours together; but in winter, when the rigour of the season would chill the principles of life, and destroy the young one,

she grows more assiduous in her attendance, and stays away but half the time. When the birth approaches, with how much nicety and attention does she help the chick to break the prison!*—not to take notice of her covering it from the injuries of the weather, providing it with proper nourishment, and teaching it to help itself; nor to mention her forsaking the nest, if, after the usual time of reckoning, the young one does not make its appearance. A chemical operation could not be followed with greater art or diligence, than is seen in the hatching of a chick, though there are many birds that show an infinitely greater sagacity; yet, at the same time, the hen, that has all this seeming ingenuity (which is, indeed, absolutely necessary for the propagation of the species), considered in other respects, is without the least glimmerings of thought or common sense. She mistakes a piece of chalk for an egg, and sits upon it in the same manner; she is insensible of any increase or diminution in the number of those she lays; she does not distinguish between her own and those of another species, and, when the birth appears of never so different a bird, will cherish it for her own. A hen, followed by a brood of ducks, shall stand affrighted at the edge of the pond, trembling for the fate of her young, which she sees venturing into so dangerous an element. As the different principle which acts in these different animals, cannot be called reason, so, when we call it instinct, we mean something we have no knowledge of. It appears to me the immediate direction of Providence; and such an operation of the Supreme Being, as that which determines all the portions of matter to their proper centres.'

The following just observations from the 'Journal of a Naturalist,' suggested by the maternal instincts of the missel-thrush, shall close this paper. 'The extraordinary change of character which many creatures exhibit, from timidity to bold-

* Addison has here fallen into the error of the earlier naturalists, that the chipping of the egg was the act of the mother; he has also committed another error, in saying that the bird frequently turns her eggs;—but his general reasoning is not affected by these mistakes.

ness and rage, from stupidity to art and stratagem, for the preservation of a helpless offspring, seems to be an established ordination of Providence, actuating, in various degrees, most of the races of animated beings; and we have few examples of this influencing principle more obvious than this of the missel bird, in which a creature addicted to solitude and silence, will abandon its haunts, and associate with those it fears,* to preserve its offspring from an enemy more merciless and predaceous still. The love of offspring—one of the strongest impressions given to created beings, and inseparable from their nature—is ordained by the Almighty as the means of preservation under helplessness and want. Dependant—totally dependant, as is the creature for every thing that can contribute to existence and support, upon the great Creator of all things, so are new-born feebleness and blindness dependant upon the parent that produced them; and to the latter is given intensity of love, to overbalance the privations and sufferings required from it. This love, that changes the nature of the timid and gentle to boldness and fury, exposes the parent to injury and death, from which its wiles and cautions do not always secure it; and in man, the avarice of possession will at times subdue his merciful and better feelings.

'Beautifully imbued with celestial justice and humanity, as all the ordinances which the Israelites received in the wilderness were, there is nothing more impressive, nothing more accordant with the divinity of their nature, than the particular injunctions which were given in respect to showing mercy to the maternal creature cherishing its young, when, by reason of its parental regard, it might be placed in danger. The eggs, the offspring, were allowed to be taken; but, 'thou shalt in any wise let the dam go,'† 'thou shalt not, in one

* It had been previously observed that this bird, to avoid the depredations of the crow and magpie, frequents our gardens and orchards during the breeding season, seeking protection from man, near whose haunts these rapacious plunderers are wary of approaching.

† I have already mentioned one of my school-boy experiments. Here is another, much less justifiable, and attended with a more distressing re-

day, take both a ewe and her young'—the ardent affection, the tenderness with which I have filled the parent, is in no way to lead to its injury or destruction. And this is enforced, not by command only, not by the threat of punishment and privation, but by the assurance of temporal reward, by promise of the greatest blessings that can be found on earth—length of days and prosperity.'*

SEVENTH WEEK—WEDNESDAY.

REPRODUCTION OF QUADRUPEDS.—THE LION—THE RABBIT.

It is unnecessary to dwell at any length on the reproductive instincts of quadrupeds, as the great principles by which such instincts are guided, have already amply appeared in

sult, which strikingly illustrates the benevolence of the Divine command alluded to in the text, and the cruelty of neglecting it. I took a brood of young chaffinches in the nest, and, having placed them in a cage, in a room, near an open window, their cries drew both the male and female to their aid. Laying aside her usual timidity, the affectionate mother flew in at the window, and rested on the cage. At that moment, by drawing a string, I suddenly closed the window, and thus made her my prisoner. My object was to get her to feed her young, with food regularly supplied to her by myself, and thus to provide for the proper rearing of the tender brood. The experiment altogether failed, and I suffered the reward of my treachery. The imprisoned female was uneasy and restless, and took little notice of her young, while the male fluttered about the window, in great agitation, but never ventured to enter. I persuaded myself, that if I could catch him also, all would be well, and I therefore secured him by means of bird-lime. Both parent birds were then enclosed in the same cage with their offspring, along with abundance of meat; but next day all the young ones, with their mother, were lying wounded and dead at the bottom of the cage. The high-spirited male preferred the death of his family to their captivity. He would probably have immolated himself also on the shrine of freedom, as he refused to eat, but I was too much shocked by the catastrophe to carry the unhappy experiment further. The bird regained his liberty, and flew lonely, and uttering plaintive cries, to his native grove.

* Journal of a Naturalist, pp. 248–250.

considering those natural faculties, as exhibited among the feathered tribes, where peculiar circumstances require them to be more complicated and more perfect. A slight notice, however, will not be uninteresting, or out of place.

The chief difference in the manner of propagating the species between birds and beasts, is, that the latter, instead of producing by means of eggs, are *viviparous;* or, in other words, the process of incubation is, with them, carried on in the womb, and the young are parted from the mother, as the chick is, after hatching, excluded from the shell alive, and fully formed. Another provision is united with this, the adaptation of which to the peculiar circumstances of quadrupeds, is also admirable, with relation to the case both of the mother and her offspring; I mean the supply of milk from the udder of the female, a secreted fluid, prepared by the profoundest alchemy, for the nourishment of the progeny, in the earlier stage of their existence. These two differences render the cares of the parent less numerous and burdensome. There is neither a nest to prepare, nor food to gather for the young; the Author of their nature has already provided both. Now, we observe a corresponding difference, adjusted with singular intelligence to these modifications. The male, among quadrupeds, never performs as important a part in the rearing of the young, as among birds. Frequently, indeed, he is altogether ignorant of the paternal feelings. It is not necessary, for the welfare of the species, that this natural affection should exist in ordinary cases, and especially among gregarious beasts; and, except where it is necessary, it has not been bestowed. The sheep, the cow, the dog in its wild state, and various others, are instances of gregarious quadrupeds, the males of which are altogether destitute of the parental instincts.

There are other kinds of beasts, however, who pair, and in whom these instincts are sufficiently conspicuous. This is constantly the case with beasts of prey, who, as I have already remarked, have to seek their food at a distance, encountering much toil, and sometimes imminent danger, and with regard

to whom it was therefore expedient that the male should be the associate and provider of the female, while tending their mutual offspring. Let us take an example, in the noblest of the brute creation, the imperial lion.

This royal animal is constant to one female. They lie in the same thicket or den; they partake of the same prey; and, when the breeding season arrives, they are animated by the same feverish excitement. Even when fierce and irritable to all others, the lion is mild and gentle to the female. That he is susceptible, indeed, of kindly and generous feelings, even to animals of a different species, has been proved by the attachments which have been known to subsist between this formidable animal, in a state of confinement, and creatures which have been thrown into his den to be devoured; and the same thing may probably be inferred from his tractability and gentleness in the hands of his keeper. But it is towards the lioness and her cubs that his affections are peculiarly alive; and some interesting stories have been recorded, indicating the tender feelings towards them, with which the Creator has endowed him. In this animal, indeed, all the passions, even those of the most gentle kind, are in excess.

The lioness, though naturally less strong, less courageous, and less mischievous than the lion, becomes terrible when she has got young ones to provide for. She then makes her incursions with more intrepidity than the lion himself; she throws herself indiscriminately among animals of all kinds, and even man, whom, in her ordinary state, she is shy of attacking, becomes the object of her fury. She destroys without distinction; loads herself with the spoil, and brings it home reeking to her cubs, whom she early accustoms to delight in slaughter. Her period of gestation is five months, and she bears only once in the year, generally bringing forth two at a time, though sometimes more. Her lair is in the most retired and inaccessible places; and, when she fears to have her place of retreat discovered, she is said, how truly I do not know, to hide her tracts, by brushing them out with her tail. When her apprehensions are strong, she shifts her

habitation, carrying the young, if newly dropped, one by one in her mouth, like the dog or cat. If attacked when performing the maternal duties, she fights with peculiar fury, defending her offspring with the most determined courage, and a love which no personal danger can shake.

Such is the account given by naturalists, of this most formidable of the brute creation. It exhibits the parental and conjugal affections not less strong in this tremendous quadruped, than in the interesting tribes which skim the air, and teaches us that the Creator has implanted, even in the fiercest brutes, the same kind of instincts, by which he has provided for the propagation of the species among birds, though these are wonderfully modified, so as to adapt them to the circumstances of each.

I shall contrast the habits of the lion with those of one of the most peaceful and defenceless of the quadruped race, in its natural and untamed state. The rabbit shall be my example. This animal, destitute of the swiftness of the hare, and the cunning of the fox, and the agility of the squirrel, has but one means of escape from danger; he burrows beneath the ground. When the necessity of procuring food, and the love which he seems instinctively to feel for the open air, tempt him to go abroad, he becomes the prey of every carnivorous animal; and the race, apparently created to be the food of the fox, the kite, and the eagle, would soon become extinct, were it not for its extraordinary fecundity. This property I noticed in the Winter volume.* It is so great as amply to compensate to the race for the defencelessness of their nature, and is one of those provisions of Creative Wisdom, by which the balance of creation is preserved.

The female prefers solitude during the period of production; and, as the holes in which the rabbits usually burrow, are common property, she frequently provides a nest for herself, on the outside of the warren, and at some distance from it, excavated about a foot deep, and filled with moss and grass. Here she suckles her young for about a month, generally

* 'Winter,' Fourth Edition, p. 79.

alone, but sometimes visited by the male, who, though he would destroy them, when newly dropped,* occasionally attends their mutual offspring, after they are grown up, nursing them in her place, when she is procuring her own food, and leading them out to feed. It is most usual, however, for the female to produce her young within the warren; but, in a separate apartment, made with a more intricate entry than the ordinary holes, at the bottom of which a sufficient space is excavated. Here she pulls off from her belly a good quantity of her hair, with which she makes a kind of bed for her young. During the two first days after their birth, she never leaves them, and does not stir out even afterwards, except to procure nourishment, which she snatches with the utmost despatch. In this manner, she suckles her young for six weeks, at which time they have become strong, and able to go abroad themselves. During all this time, the male seldom visits the apartment; but when they are grown up, so as to come to the mouth of the hole, he then seems to acknowledge them as his offspring, takes them between his paws, smooths their skin, and licks their eyes. All of them, one after another, have an equal share of his caresses.

These specimens, taken from two very different tribes of animals, may suffice to show that peculiar modification of the reproductive instincts, by which the Creator has admirably accommodated them to the circumstances of the animals endowed with them, thus affording, in this department of his works, additional evidence of Divine skill and benevolent contrivance.

SEVENTH WEEK—THURSDAY.

REPRODUCTION OF QUADRUPEDS.—INSTINCTS OF THE YOUNG.

THERE is a curious experiment, made by Galen, which Mr. Ray has copied from his narrative illustrative of the in-

* It is probably from jealousy of the female's affection for the young, that the buck shows enmity to their offspring.

stinctive habits of the young of brutes. It is as follows, in the words of Mr. Ray's translation :—' Nature, forming, fashioning, and perfecting the parts of the body, hath so brought it to pass, that they should, of themselves, without any teaching, set about, and perform, their proper actions; and of this I once made a great experiment, bringing up a kid without ever seeing its dam; for, dissecting some goats, great with young, to resolve some questions made by anatomists, concerning the economy of nature, in the formation of the fœtus in the womb; and, finding a brisk *Embryon* (young one), I loosed it from the matrix, after our usual manner, and, snatching it away before it saw its dam, I brought it into a certain room, having many vessels full, some of wine, some of oil, some of honey, some of milk, or some other liquor; and others, not a few, filled with all sorts of grain, as also with several fruits; and there I laid it. This embryon we saw first getting up upon its feet, and walking, as if it had heard that its legs were given it for that purpose; next shaking off the slime it was besmeared with from the womb; and, moreover, thirdly, scratching its side with one of its feet. Then we saw it smelling to every one of those things that were set in the room; and, when it had smelt to them all, it supped up the milk; whereupon we all, for admiration, cried out, seeing clearly the truth of what Hippocrates saith, that the nature and actions of animals are not taught, but by instinct. Hereupon I nourished and reared this kid, and observed it afterwards, not only to lap milk, but some other things that stood by it; and, the time when this kid was taken out of the womb, being about the vernal equinox, after some two months, were brought to it the tender sprouts of herbs and plants; and it again, smelling of them all, instantly refused some, but was pleased to taste others; and, after it had tasted, began to eat of such as are the usual food of goats.

' Perchance this may seem a small thing; but what I shall now relate is great; for, eating the leaves and tender sprouts, it swallowed them down, and then, a while after, it began to chew the cud, at which, all that saw it, cried out again, with

admiration, being astonished at the instincts and natural faculties of animals; for, it was a great thing, that, when the creature was hungry, it should take in the food by the mouth, and chew it with its teeth; but, that it should bring up again, into the mouth, that which it had swallowed down into its first stomach; and, chewing it there a long time, it should grind and smooth it, afterwards swallow it again, not into the same stomach, but into another, seemed to us wonderful indeed. But many neglect such works of nature, admiring only strange and unusual sights.'

On this account, Mr. Ray makes the following observations:—'This pleasant and admirable story, should one consider all the particulars of it, and endeavour to give an account of them, as also all the inferences that might be drawn from it, one might fill a whole volume with comments upon it. All that I shall at present say is this, that, in all this economy, and these actions, counsel and design doth so clearly appear, that he must needs be very stupid that doth not discern it, or impudent that can deny it.'

It is impossible not to assent to these observations; but, after all, the only thing unusual in the account, is the absence of the mother, and the impossibility of the kid learning any thing from mere imitation—an idea which could scarcely occur to a rational inquirer. The very same thing happens every day. It is true, indeed, that the embryon, as he calls it, drew its food from a vessel, and not from its mother's nipple, but the one process is not less remarkable than the other. Indeed, nothing can be more admirable than the whole contrivances and adaptations by which this grateful and nutritious liquor is prepared, and rendered available for the subsistence of the young. The udder itself is composed of an immense number of glands, or secreting vessels, where the milk is formed, each of which has its duct, through which it is conveyed, first into small trunks or branches, and then into one large excretory vessel; and this, before it enters the nipple, is contracted to such a degree, that it will scarcely admit a small bristle to pass into it. By this beautiful artificial contrivance,

the milk is prevented from flowing out of itself, while it is made ready easily to flow out, when acted on by suction or pressure. Corresponding to this, and most evidently forming a part of the same contrivance, is the mouth of the young, formed for suction; and, at that early stage, divested of teeth, which would at once be an annoyance to the mother, and an unnecessary appendage to the offspring.

But I must farther remark, that the various actions which Galen observed, with such admiration, in the kid, have their analogies in the young of almost all quadrupeds, and are indeed necessary to the propagation of the species. In the insect tribes, these instincts are not less complete. Every one who has the advantage of a glass-hive, must have remarked, with delight, the motions of the young bee, when it emerges from its waxen cradle. It stands, for a minute or two, on the comb, by the side of its cell, holding as steadily, with its tiny feet, as if it had known their use for months; it then cleans itself with its fore-legs and antennæ, with admirable adroitness, rubbing its body, and smoothing its wings; and, after this slight preparation, it walks deliberately, and without any teaching, along the comb to the mouth of the hive, where it instantly mounts into the air, and finds its way to the honey-bearing flowers, employing its wings and its proboscis as skilfully as if it had been taught the art of flying, and of imbibing it selected food, by the most accomplished master. By such a master, indeed, it has been taught; but that master is no other than the Unseen Creator.

I am reminded, by the course of these observations, of an instinct belonging to the winged tribes, in the feeding of their young, to which I have not yet adverted, but which is not less remarkable than those already mentioned. I state it in the words of Ray:—'That birds which feed their young in their nest, although, in all likelihood, they have no ability of counting the number of them, should yet (though they bring but one morsel of meat at a time, and have not fewer, it may be, than seven or eight young ones in the nest together, which, at the return of their dams, do all at once, with equal

greediness, hold up their heads and gape), not omit or forget one of them, but feed them all; which, unless they did carefully observe, and retain in memory, which they had fed, which not, were impossible to be done,—this, I say, seems to be most strange and admirable, and beyond the possibility of a mere machine to perform.'*

SEVENTH WEEK—FRIDAY.

MAN.—EFFECTS OF PROTRACTED CHILDHOOD ON THE INDIVIDUAL.

We are now arrived at the highest state of organized existence, in which the most perfect of all the bodily forms is united with an immortal soul, capable of being stimulated to unwearied exertions, susceptible of endless improvement, and glowing with desires which rise beyond the bounds of time. In recording the formation of the inferior classes of living beings, it is merely stated by the sacred historian that God said, 'Let them be;' but when the formation of man is recorded, it is declared, that 'God created man in his own image;' and that 'he became a living soul.' This emphatically marks his nobler faculties and his higher destiny. But when, by the fall, his nature was degraded, and his hopes were blasted, he was doomed to live on earth an imperfect and sinful creature; and, doubtless, one of the Providential means by which the curse he had entailed upon himself was communicated to his posterity, was the appointed condition of their mental powers in the earlier stages of their existence. The maturity of their appetites and passions was thenceforth to precede the maturity of their rational and moral faculties, and thus to obtain a superiority which was to destroy the well-adjusted balance of their nature, that constituted the perfection of man when he came from the hands of his Creator.

Man was not, however, to be left without some counteracting circumstances, which should tend to prevent this condi-

* Ray on the Creation, p. 107.

from becoming altogether fatal to his intellectual progress, and his virtuous aspirations. Among these the most powerful, and the only one I shall at present notice, is what results from the other conditions in which during infancy he is placed.

Of all the animal creation, the bodily powers of man are by far the longest of being fully developed. He comes into the world a helpless infant, totally incapable of providing for his own subsistence. He is thus for several years thrown entirely dependant on the good offices of his parents. I have already noticed this as a wise Providential arrangement;* but as it is one of the peculiar adaptations connected with the reproduction of the species, it seems here to require a more particular examination.

If any person were but for a moment to consider what would be the necessary result of an opposite condition, he would perceive at once the wisdom of the provision. Let him suppose, what might assuredly have taken place had the Creator so pleased, that the child was formed so as to rise to bodily strength, and to be able independently to find the means of subsistence in the same short period as the young of a sheep, a cow, or a horse, what would be the consequence to himself, to his parents, and to society? It is obvious to the reflecting mind at a single glance, that in every one of these particulars, the effects would be injurious; but all the evil results cannot easily be perceived without some consideration. Let us then inquire into this matter.

Observe the consequence to himself.—We shall best do this by first considering the discipline which a child actually undergoes under the roof of his parents. The earliest enjoyments of which he is conscious, arise from the tender assiduities of maternal fondness.—His smile responds to that of his mother; when he weeps, it is her soothing voice which calms the inward agitation of his feelings; when he is hungry, it is from her bosom that he draws the sweet food with which his appetite is satisfied; when he becomes fatigued and listless, it is her lullaby which charms him to sleep; and, clasped in

* 'Winter,' Fourth Edition, p. 305. See also p. 121 of this volume.

her arms, it is on her soft and gentle breast that he pillows his head. Thus a sympathy is excited between the parent and child, which has a powerful effect on his character. He learns to lean upon his mother for that support of which he stands in need, to look up to her for enjoyment, to hang on her looks with a tender interest. His benevolent affections, in short, are called forth and exercised; and, along with these, arise a feeling of natural helplessness; a salutary sense of dependance on a superior; docility, and a desire to please; which complete the filial, and lay the foundation of the religious, affections. These filial charities and duties, thus early called forth, are exercised and expanded during a period which occupies not less than the fourth part of our sublunary existence; and, thus riveted on the character, become a second nature; or, at all events, so modify and control the moral powers, as to give them a salutary direction through life. It may be difficult to determine to what degree any of the qualities and tendencies I have mentioned would influence the mind of man, were he not by the very necessity of his circumstances thus trained, coerced, and moulded; but that much of what is amiable and estimable in his character would be lost, no person can doubt. Alas! notwithstanding all the training of the domestic roof, what proofs remain of the debasement of our moral powers!

But this is not all.—Besides the moral effect thus produced, the influence of this long state of filial dependance is scarcely less salutary on the intellectual powers. Under a parent's roof, the mental faculties are excited and cultivated. The little attentions of maternal fondness all tend, unconsciously even to the mother herself, to awaken the curiosity, to exercise the reason, and stimulate the ingenuity of her child. When she first teaches him to grasp the offered toy, and leads him to use his rattle, or to chuckle with delight while she forms for him a horse of his father's cane, new ideas are constantly rising in his mind, and a habit of mental activity is forming, which is not without its permanent influence. Were we to follow the domestic discipline after the child

leaves his mother's lap, we would find still greater reason to admire the divine wisdom, which has thus provided for the development of his rational powers. It is a parent's authority which not only restrains the evil passions as they rise in his childish breast, but trains him to a course of mental improvement. It is the persuasive eloquence of a beloved mother's admonitions, or the reverential awe of a father's command, which induces the youthful mind to forego its indolence and love of amusement; to acquire useful but irksome instruction in the public school, or under the anxious and experienced eye which presides over the domestic circle.

Let us now look for a moment to the supposition with which we set out.—Imagine man exempted from this long-protracted pupilage, and rising to the full vigour of his bodily powers in a few weeks or months, and consider the result. Being thus early rendered independent of parental tenderness and support, the endearing tie, which binds the parent to the child, and the child to the parent, would at once be materially weakened. That ceaseless assiduity and inexhaustible tenderness which is called forth on the part of the mother, by the utter helplessness of her infant charge, would abate with the necessity from which it sprang. She would still love him indeed, but her affection would be less deep and exclusive; she would still attend to his wants, but they would be less numerous and pressing, and their urgency would cease before they had been formed into a permanent habit, and had entwined themselves very strongly round her heart. On the part of the child, the effect would be still more injurious. The love and gratitude which parental kindness now engenders, if it existed at all, would be very greatly diminished. There would be no remembrance of the mother's long nights of watching, and the father's days of unwearied toil, to enhance the feeling;—no consciousness of that generous parental regard, which sacrifices self for the welfare of his child, or, at least, no depth of tender sympathy, excited by that consciousness, and rendered indelible by the experience of many years. As the youthful mind expanded, the heart would grow callous. Selfishness,

which even now takes so strong a hold of the human character, would then possess it undivided;—there would be no melting charities, no relenting ruth; from generation to generation the degeneracy would increase, and the whole earth would probably become a habitation of cruelty.

The same deteriorating influence would extend to the intellectual world. The mental powers would cease in early youth to be cultivated. Emancipated from parental control, the childish and inexperienced man would refuse the drudgery of school, and all those painful exercises of mind which train it to learning. There would be no books, no study, no science. The untutored mind would remain without light and without employment,—a savage with tenfold more darkness, ferocity, and intense selfishness, than the most uncultivated and fierce of the savage tribes of Africa.

It were easy, but seems unnecessary, to follow this part of our subject farther. It is clear and undeniable, that for man, constituted as he is, the early discipline of a father's roof is of most essential importance; that even supposing the picture I have drawn to be overcharged, of which I am by no means aware, yet, to say the very least, without such discipline the moral character would be still more defective than it is, and the intellectual powers obtuse and uncultivated; and that therefore, with reference merely to the effect on the child, the arrangement which leaves him long weak, helpless, and dependant, unequivocally argues the contrivance of Divine wisdom and goodness.

SEVENTH WEEK—SATURDAY.

MAN.—EFFECTS OF PROTRACTED CHILDHOOD ON THE PARENTS AND ON SOCIETY.

It is not on the young alone that a salutary effect is produced by the protracted period of infancy. Whatever, indeed, forms the character of the child, provided the effect, as

on the present supposition, be permanent and universal, must, in the second generation, influence the character of the whole race, so that there would be much reason for thankfulness, even although the arrangement in question were tc produce no other direct advantage, than that on which I have already commented. But, besides the character formed in childhood under a parent's roof, there are benefits arising to the parents themselves, from the lengthened state of dependance which the Creator has entailed on their children.

It is the cement of the marriage tie. Man, like many of the inferior creatures, is a gregarious animal, and, in this state, we seldom find that any very close and endearing connexion subsists between the parents, except, as in the case of birds, the production of offspring be attended with many cares, extended over a considerable period. It is easy to see, that the very same principle operates with man as with the birds. The husband 'leaves his father and mother, and cleaves unto his wife, and they twain become one flesh.' And what renders this intimate and permanent connexion a natural as well as a commanded duty? Chiefly, though not solely, the tie formed between them by a helpless family, mutually endeared as being their own flesh and blood, and depending wholly upon them for support and education. There is here a bond of union of long continuance and of great responsibility, even where there is only one child; but frequently renewed by additional progeny, and increasing with the increasing family. In the rearing, training, and providing for these pledges of mutual love, their sympathies are strongly called forth, their energies are united, their labours are lightened, their sorrows are alleviated, their hopes and enjoyments are exalted. Affection begets affection. The glance of love flashes from parent to parent, and then from the parents to their fondly cherished offspring; whence it is reflected with a softened lustre from the guileless eyes of infancy and childhood. The endearing influence spreads and accumulates. Mutual benefits, conferred and received, complete the union; and thus are formed and rendered permanent the tender charities of do-

mestic life; which, in reference to the intercourse of human beings, constitute at once the most important of man's earthly duties, and the most ennobling of his earthly enjoyments.

But the stimulus which parental love excites is not confined in its advantages to the family circle. Industry is necessary for the supply of domestic wants; and industry is the road to wealth. 'The hand of the diligent maketh rich;' conveniences succeed to necessaries; comforts to conveniences; and so the stimulus urges forward. Ingenuity is demanded; invention succeeds; the produce of the rivers and the forests are put in requisition; the powers of the soil are called forth; the arts and sciences take their origin and are cherished; and man, rising as he advances, emerges into civilized life, and becomes conscious of powers, susceptible of enjoyments, and capable of an expansion of mind, which, in the ruder stages of society, he could not even comprehend. And all this arises, or at least receives strength and permanence, from that one arrangement on which the domestic bond is founded,—the protracted period of pupilage.

Nor is even this all. From the patriarchal state, government and the social compact take their rise, and all the advantages accrue, which are secured by a well-regulated and closely-united community. The mutual relation of parent and child, implies authority on the one hand, and obedience on the other. This is the principle on which all government is founded; and we may well doubt whether, if family ties did not exist, men would ever unite together in communities, and place themselves under the useful restraints of law. If not, then the hope of improvement would be at an end. 'Every man would do that which was right in his own eyes;' and rapine, oppression, and bloodshed, would pervade the world.

'There is a holy tenderness,
A nameless sympathy, a fountain love,—
Branch'd infinite from parents to their children,
From child to child, from kindred on to kindred,
In various streams, from citizen to citizen,

From friend to friend, from man to man in general,
That binds, supports, and sweetens human life.'*

Then, again, consider what would be the state of religion, that softener of the manners, that enlightener of the mind, that solace and hope of the heart; that bond of union and of sympathy among brethren. Doubtless the Spirit of God might move over the chaotic and jarring mass of humanity, as he at first moved on the face of the waters, and produce a new moral creation,—a power which, under all circumstances, indeed, must be exerted before fallen man can be renewed in the spirit of his mind. But who does not perceive, that, under the circumstances we are supposing, the world of mankind would be totally unprepared for such a change. At present, they have learned, in the school of domestic discipline, to reverence, to love, to trust, and to obey their parents, and their affections have early and habitually gone forth towards their brothers and sisters. Here God has laid a foundation for the religious principle. It is but transferring the filial affections from an earthly to a heavenly Father; from their brethren of the family circle, to their 'elder Brother' before the throne of the Eternal; and thence, by reflection, down again to earth, that all the large family of the second Adam may be bound together by the ties of spiritual brotherhood. But if there were no domestic training and sympathies, those principles on which the religious affections are founded, would be in abeyance in the human character. There would be a want of preparation, and an obtuseness of feeling exceedingly unfavourable for the operation of religious convictions and spiritual mindedness. The soil on which the seed of Divine truth was to be sown, would be barren and impenetrable. God, indeed, could still fertilize it; and sometimes he shows the sovereignty of his grace, by bringing unexpected fruit from the most unpromising soil; but this is not the way in which the Holy Spirit usually works. When the Son of God appeared, he found the world prepared for his reception, by a long period of previous training: and so it is in the or-

* Thomson's Sophonisba.

dinary course of Providence; when Divine grace converts a soul, it generally operates on principles and feelings already in exercise, though misapplied, perverted, and debased. Of this we have a memorable instance in Saul the Persecutor converted, and applying the same characteristic zeal in a new direction, when he became Paul the Apostle. And thus we find it here. God has 'set the solitary in families,' that they may imbibe and cherish principles, which require only to be changed to a more exalted and more worthy object, and, by the infusion of a new principle, to be refined and sanctified. Reverence, love, and gratitude,—docility, submission, and obedience, have already been cultivated in the domestic circle, and are in frequent exercise. They have but to be enlightened, purified, and ennobled, by faith in the Saviour of sinners; and the joyful change is effected.

From these remarks, I think it will appear, that the peculiar arrangements which give rise to the domestic charities, the chief foundation of which, as I have said, is to be found in the protracted period of childhood, indicate the existence of an intelligent Designer, who is thoroughly acquainted with all the secret springs of the human mind, and who has employed a wisdom truly divine, in the provision He has made for calling them forth, and exercising them.

EIGHTH WEEK—SUNDAY.

ON CHRISTIAN LOVE.

Charity, says an apostle, is the bond of perfectness, that strong and important tie, by which, among believers, heart is united to heart. The christian faith is no less remarkable in this respect, than in respect of what has been more emphatically called its peculiar doctrines, that it places the foundation of morality, as well as religion, on the principle of love. In the two preceding papers, I have adverted to the Providential

arrangements by which the affections of the heart, which constitute this principle, so far as it is naturally inherent in the mind, are called into action and cultivated. Let us now regard it as a religious duty.

I shall at present confine myself to the consideration of the love which we owe to our fellow-creatures, merely observing, with regard to this duty, as relates to the Author of our Being, and the Saviour of our souls, that it is the cultivation of that higher principle which gives to the social affection its most ennobling character; and, indeed, to speak more correctly, it is from love to God that love to man must flow, before it can deserve the name of a christian principle. God is our Creator, Preserver, and Governor; or, to state all in one word, our *Father;* we are therefore bound to each other by the endearing relation of brotherhood. Christ is our common Saviour; and this forms a new tie of a still closer and more tender kind. If, on the natural bond which unites the members of a family together, and thence extends to the great family of mankind, this more exalted principle be superinduced, a union will be formed which may well be called the cement of society. The love thus called forth, was so conspicuous for its strength and disinterestedness among the early followers of Jesus, as to excite the admiration and envy of their heathen neighbours, and gave rise to the well-known exclamation, 'Behold how these Christians love one another!'

The sentiment is of a similar nature among believers in the present day, though its intenseness is no longer exhibited by enduring the horrors of persecution, nor its highest exercise called forth by sympathy with common dangers and impending death. It is the union of a great family in love to one Father and Elder Brother, whence the mutual affection descends in the kindliest influences on the whole household. There is a remarkable figure by which an apostle illustrates the union thus formed; he represents christian society under the image of a human body, of which Christ is the head, and every individual believer is a member, and hence he infers, that 'we are members one of another;' that each member

has its own particular office assigned to it, which, if properly employed, is of benefit to all the rest; and that the whole 'being fitly joined together, and compacted,' forms 'a perfect man.' This beautifully shows forth and enforces the various offices of christian love. There are 'many members, yet but one body; and the eye cannot say to the hand I have no need of thee; nor, again, the head to the feet, I have no need of you; nay, much more, those members of the body, which seem to be more feeble, are necessary. God hath tempered the body together that there should be no schism; but that the members should have the same care one for another; that whether one member suffer, all the members suffer with it, or one member be honoured, all the members rejoice with it.'

A similar sentiment is expressed by our Saviour himself, when he says, 'A new commandment I give unto you, that ye love one another, as I have loved you, that ye also love one another.' There is a natural affection which men, as the descendants of a common parent, should entertain for each other; but here is a stronger bond formed between believers, by the love of Christ. It is a *new* commandment.

What a happy society would the christian world form, if that spirit of love were diffused over it, of which the great Founder of our faith exhibited so eminent an example. There are, indeed, many unavoidable evils of life, but how few and trifling are these, compared with the calamities which men bring on themselves by vicious indulgences, and especially by giving way to the malevolent passions. The winter may be stormy, but it is counterbalanced by the delights of spring, summer, and autumn. Disease may sometimes afflict us, but how small is the proportion of sickness to health. Loss of friends may distress us; but here religion comes with its consolations, and the Christian does not sorrow as others who have no hope. Though evil exist in the world, then, it does not naturally preponderate in the world; and, if we are unhappy, this must be owing either to the evil passions of our own hearts, or the malignity of others. Were we but to fulfil

towards each other the perfect law of love, even this present sublunary state would be full of enjoyment.

It is surely superfluous to use many words, in order to show how necessary mutual love is to happiness. We need only look among our own acquaintances to be convinced that domestic harmony or discord is of more weight in the scale of social happiness or misery, than all other circumstances connected with our lot in this world taken together. Who can pass a single day without having the truth of Solomon's observation forcibly impressed on his mind, 'Better is a dinner of herbs, where love is, than a stalled ox, and hatred therewith.' Pleasures and pains of this kind, have a powerful tendency to diffuse themselves. A benevolent countenance sheds beams of joy on a whole circle, while a lowering and discontented brow brings gloom, and blights enjoyment. 'A greater punishment could not be inflicted on any rational being,' says Dr. Enfield, 'than that he should be rendered incapable of loving; nor can a more lively idea be formed of the wretchedness, as well as the depravity, of the prince of evil demons, than that suggested by the poet, when he makes him say,

"Evil, be thou my good."'

The converse of this sentiment is no less true, that there is no pleasure so great as that which arises from the cultivation of the affections. Of these, the highest of all are the religious; but it is of the benevolent that I at present speak. David was deeply sensible of this, and has beautifully expressed his feelings with regard to both. Speaking of the latter, he says, 'Behold how good and how pleasant a thing it is for brethren to dwell together in unity.' He compares it to the holy ointment with which Aaron was consecrated to the service of God, at once graceful and ennobling; and to the dew which descended on the mountains of Zion, sparkling with many colours, in the beams of the morning, and shedding refreshment and fertility around. Paul has equally extolled this virtue, in that celebrated passage in his Epistle to

the Corinthians, in which he describes it under the name of charity. His last characteristic of this principle is that which crowns the whole. It survives death, and is perfected in heaven. 'Charity never faileth; but whether there be prophecies, they shall fail; whether there be tongues, they shall cease; whether there be knowledge, it shall vanish away; for we know in part, and we prophesy in part; but when that which is perfect is come, then that which is in part shall be done away.' 'And now abideth faith, hope, charity,—these three; but the greatest of these is charity.'

Love is, indeed, the perfection of our being, and the source of our highest happiness. It is the very soul of angelic natures; and the cultivation of it on earth, is the best preparation for the heavenly society, when time shall be no more. The various arrangements, therefore, alluded to in former papers, by which the domestic and social affections are called forth and exercised, have a far higher ultimate object than that of binding society together, and contributing to our enjoyments in our present imperfect state. They have reference to eternity, and the faculties which they cultivate shall find their noblest exercise in heaven.

But the union of heart to heart, of which I have here spoken, is not attainable by fallen man, in his present state, without the infusion of a higher principle; and it is in the purification of his affections that the change induced on the mind by Divine grace, chiefly consists. The mere natural feeling, although one of the purest and most tender which inhabit the hearts of the race of Adam, is yet tainted and debased. It is the Holy Spirit restoring the image of God to the soul, which alone can ennoble it. Under His influences, friendships of earth are converted into a heavenly brotherhood, and, becoming divine, are rendered immortal.

EIGHTH WEEK—TUESDAY.

THE DIFFERENCE BETWEEN THE OPERATIONS OF REASON AND INSTINCT, AS AFFORDING ARGUMENTS IN FAVOUR OF THE DIVINE PERFECTIONS.

In turning, as we are now about to do, to the effects produced by the exercise of the rational faculties of man, in aiding the productive powers impressed on nature, it will be necessary to attend to some circumstances, which serve, in a certain degree, to give a new character to our reasoning. The instincts by which the lower animals perform the important offices necessary for the production and rearing of their young, are obviously contrivances with which they have nothing to do, further than to execute a task assigned to them by a Superior Power. It is clear that there is a great end to be attained, that they perform certain actions necessary for the attainment of that end, and yet that they are altogether unconscious of the part which they are acting, and even entirely ignorant of the end itself; and it hence follows, that every movement which they make, tending to the preservation of their species, comes irresistibly home to our understandings, as a proof of wise intention, not in themselves, but in the Unseen Author of their nature. Thus, when the bird builds its curious nest, and, having deposited its eggs, patiently broods upon them for the appointed time; and then, after the fostering warmth of her body has produced the callow young, when she tenderly watches over them, catering for them with the most assiduous toil, and teaching them to flutter their little wings, to sport in the liquid air, and to forage for themselves; in all this, it is impossible not to perceive, that, by whatever second causes such instincts are prompted, they can be no other than the original ordination of Creative Intelligence.

It is different, however, with the labours of man. He too, indeed, has his instinctive propensities, some of which have

for their object the production and preservation of the species; while they lead, as we have seen, by necessary consequences, to important results, which he neither contrived nor anticipated; and, thus far, the argument is the same for him as for the brutes. But he is also endowed with rational powers, in virtue of which he speculates on the future, and, pursuing the conclusions of his own mind, lays plans on which he acts, and bends the powers of nature to his will. It is in this way that he proceeds in his agricultural schemes and employments. They are the fruit of his own skill. He has reasoned on the properties and functions of the soil, and of its vegetable productions, and on the vicissitudes and the genial powers of the climate; he has profited by his own experience, and that of others; and thus he converts the barren waste into a fruitful field, and causes the desert to blossom as the rose. There is here something altogether different from instinct; and, in looking for the hand of the Creator, we find another, and seemingly independent, intelligence at work, which interrupts our view, and causes us to consider the matter more deeply. We have, however, but to turn back a single step. Who endowed man with his rational faculties? Who so contrived the soil, and the vegetable world, and even the seasons themselves, as to be subservient to the use of man, and under the control of these rational faculties? Undoubtedly the same Eternal Being who bestowed on the rest of the living world their instincts. Every thing, therefore, resolves itself ultimately into the appointment of Creative Wisdom.

But, besides this original creation, there is a superintending Providence, which guides, controls, and overrules all events, so as to render that in reality a providential occurrence, which appears, at first sight, to be the mere result of human ingenuity. Look, for example, at the invention of the steam-engine, which has caused, and is now causing, so great a revolution in human affairs, by bestowing on man such extraordinary powers. It was the Creator who endowed steam with the amazing expansive force which it possesses, and with the quality of instant condensation by cold. It is true, that

these properties remained long unemployed,—that for many ages the steam poured uselessly from the tea-kettle and the caldron, and, though so familiar to man, was passed by without a suspicion of the benefits it was capable of conferring. But the powers were *there*, ready to be used when the progress of society demanded their aid; and the human faculties were, meanwhile, undergoing a discipline and a training, which sharpened their ingenuity, and added activity and enterprise to skill; knowledge accumulated, human wants increased, commerce extended, manufactures rose in importance. It was *then* that a force was required, which might give new energy to human exertions, and proportion them to the growing demands of society. This was sought for, and found to be at hand. Is any one so sceptical as to deny, that, though the steam-engine be the result of human contrivance, steam itself received from its Creator its extraordinary qualities, for the express purpose of becoming thus, at the proper period, subservient to the wants of man?

And what is human contrivance? Is it not the result of faculties impressed on the mind by the hand of the Eternal, and brought to maturity by the various adaptations, incitements, and suggestions of His providential arrangements? In every way, then, the invention in question may be traced, by a devout mind, to the Supreme Being, as its final cause.

Now, this is but an example of the operations of Providence, as they regard the rational creature. The believer sees the Divine Hand everywhere, and the light which is thus thrown on the operations of Nature, in connexion with human reason, is most wonderful and edifying.

But, although this view is altogether satisfactory to a mind already, by other evidence, convinced of the being and perfections of the Infinite Creator, I am by no means sure that the same train of reasoning can be brought to bear against the prejudices of the infidel, with a force at all equal to that which overpowers him in contemplating the blind, and yet intelligent and admirably contrived, operations of instinct. Here the intelligence and contrivance, as I have said, being,

obviously, not in the animal itself, force us to look up to the unseen Creator; but, with regard to the actions of rational creatures, it is much easier to rest in the second cause. An objector may say, 'I see, in the human faculties, sufficient power and intelligence for the production of such a piece of mechanism, or for the contrivance of such an improvement; —on the one hand are the materials, and on the other are the results of his ingenuity in operating upon them. I rest here, and see no reason to go farther.' When we are opposed by such an objection as this, we are thrown back upon the independent arguments from which Creative Wisdom and a Superintending Providence are adduced; and, convincing as the reasoning is to ourselves, we feel that it is not suited to such a frame of mind as that of our opponent.

In speaking, then, of agricultural improvements produced by human ingenuity, the only argument we can hold with the atheist is this,—that there is an astonishing and obviously intended adaptation, in natural objects, to human wants, and to the powers and faculties of the human mind. The one is, in every respect, suited to the other; and in that suitableness there is creative contrivance. To this extent, at least, the infidel may be met upon his own ground.

EIGHTH WEEK—TUESDAY.

ORIGIN OF AGRICULTURAL LABOUR.

That every thing is made for the use of man, is a sentiment not more proud and exclusive, than it is false; if, by this expression, be meant, that *his* advantage and enjoyment alone have been consulted in the formation of the world. But though the Creator, doubtless, regarded the welfare ofeach class of his creatures, when he called them into existence, and in this view they may be justly said to be created for their own sakes, yet He has so united all these classes together, as to form one great and harmonious whole, and, by most wonder-

ful adaptations, has so beautifully adjusted all the relations, both of the animate and inanimate world, that every thing may, in a certain sense, be said to be created for all the rest. In this sense, the observation applies, with peculiar force, to man, the only rational being in this sublunary creation. Let us thus regard the various phenomena of Spring.

The general aspect of Nature, we have already noticed as a source of delight to the mind of man. The miraculous power, which, at this season of the year, seems everywhere to be exerted to call a dead world into life and beauty,—in the vegetable kingdom, the shooting of the tender blade, the expanding of the buds and leaves, the opening of the blossoms, —and in the animal kingdom, the variety of forms that are seen on every hand springing into life and enjoyment, with the instinctive habits and functions by which the different tribes are preserved and nourished,—while they afford a deep interest to the taste, furnish a never-failing subject for the exercise of the rational powers, and for the cultivation of the devout affections.

But there are active duties, also, which this pleasing season imposes on the human race, arising from that early sentence of the Creator, which included at once a denunciation, a permission, and a command, 'In the sweat of thy face shalt thou eat bread, till thou return to the ground.' It has been justly said, that all the riches of the world arise from its vegetable soil, which forms the original nourishment of animal existence. But the soil may be improved by cultivation, and hence the utility of labour. Did it bring forth, indeed, spontaneously, all that was necessary for human subsistence, it would neither require nor receive that aid which is now bestowed on it by the skill of man. It is sheer necessity which first calls forth those exertions, whereby the curse is mitigated, and crops of useful grain are made to wave on the surface of the earth, instead of 'thorns and thistles.' The process is plain by which this necessity is created, and it argues, in no slight degree, the exercise of designing Wisdom. In a wilderness, untouched by the plastic hand of man, the general state

of vegetation stands thus:—there is a vast profusion of grass and other succulent herbs, along with numerous seeds and fruits, fit for the use of the lower animals, who are incapable of agricultural labour,—'who neither sow nor reap, nor gather into barns.' These, as our Lord beautifully remarks of the fowls of the air, are fed by our common Father; but, among that bountiful provision for them, there are comparatively few plants of spontaneous growth, on which man can subsist. There is nearly everywhere a sprinkling, as it may be called, of fruits and seeds, which he can use for food, but nothing more;—enough to afford nourishment to a few scattered families, but not enough for a numerous population. Exercise is necessary for the health, both of his corporeal and mental powers, and his native indolence must be roused by necessity. The scantiness of his natural food is, therefore, a wise provision, suited to the constitution of his fallen nature, and which cannot be too much admired.

To show its beneficial operation, I must mention another principle, which is common to man with the inferior creation,—the tendency to propagate the species up to and beyond the means of subsistence. This occasions want; and want stimulates industry and ingenuity. A few words will illustrate this. Suppose a pair of the human race thrown on a desert island, and entirely cut off from the rest of the world. They would probably find, in the fruits of the trees, the seeds of plants, and the animals which fell into their power, the means of immediate subsistence. They would produce a family, however, and these would propagate again, till, in process of time, the spontaneous growth of the island would begin to be exhausted. But before this period had actually arrived, it would be anticipated; and their ingenuity would be called into exercise, to increase the means of subsistence. They would invent instruments for entrapping or killing the wild animals with which their place of residence was stored, or for drawing the fish from the sea with which it was surrounded. The first rudiments of agriculture would also be commenced. Fruit-trees would be planted near their dwell-

ings; and small patches of ground would be dug, in which some useful plants would be cultivated. These latter operations suppose the invention and formation of some rude instruments of agriculture.

But, at length, these labours would begin to fail of producing sufficient food; and what was begun merely as an exercise of ingenuity, or an arrangement of convenience, would come to be followed, at first, as a profitable, and afterwards as a necessary, employment. Still the population would continue to increase. A constant demand would thus be made on the inventive faculties and the active powers. New and better constructed instruments would be formed for turning up and pulverizing the soil; greater and greater portions of land would be taken into cultivation, first in the open valleys, and then by encroachments on the woods and mountains. Manure would be applied; better modes of agriculture would be suggested by experience, and eagerly adopted; fresh species of plants, fit for food, would be sought for, and propagated; land would be drained, and swamps cleared. Meanwhile, animals might be discovered fit for the use of man, which it would be convenient to have always at hand, instead of seeking for them in their native haunts. The young of these would be brought home and tamed; and thus flocks and herds might become part of the possessions of this increasing population.

This rapid sketch, imperfect though it be, may serve to show the wise providential arrangement by which man is stimulated to industry, and his mental faculties are exercised. The comparatively scanty provision made for his subsistence in the natural state of the vegetable kingdom, and the power which belongs to him of increasing that provision in proportion to his wants while these wants accumulate upon him as the population becomes more numerous, are some of the most powerful means ordained by the Creator, for rousing his active powers and urging forward the progress of society; and thus we observe a very remarkable proof of intelligent and benevolent adaptation between the human faculties and the state of the external world.

EIGHTH WEEK—WEDNESDAY.

ORIGIN OF PROPERTY IN THE SOIL, AND THE DIVISION OF RANKS.

The necessity of labour in propagating the fruits of the earth, gives rise to a division of property in the soil. For the sake of simplifying the subject, we yesterday supposed a pair placed in an unknown island, and thus limited in the extent of territory from which they and their progeny could draw the means of subsistence.—But this supposition is by no means necessary; for such is the expansive power of the principle of reproduction in man, that, although placed in the wide world, with all the fertility of a tropical region to call forth the produce of the earth, the species would soon be multiplied beyond the means of comfortable subsistence, without the use of artificial resources. Abundance defeats itself. Such is the power of increase, that just in proportion to the means of subsistence, the population is rapidly filled up, and labour becomes necessary for increasing the supply.

'Let us suppose,' says Bishop Sumner, 'a couple in the situation of the first created man and woman, having the world all open before them. Here the idea of scarcity seems entirely precluded. Let them take possession of a district, consisting of 200,000 acres, which, according to the average power and cultivation of land in Great Britain, would support 100,000 persons.* Reckon twelve persons at the end of the first twenty years; who, under such favourable circumstances, would certainly, taking one period with another, multiply according to the quickest known increase of the species, and double their number every fifteen years.† Within a hundred and forty years from the creation, these twelve persons would have about 3000 descendants, which, in sixty years more, would ascend to 49,152. One generation farther

* Wayland on Poor Laws, p. 273.

† This is the rate in the back settlements of America. Sir William Petty supposes a doubling possible in so short a time as ten years.—*Malthus*, i. 7.

would give us 98,304 persons, and carries us already as far as the point to which population can possibly go, the point of subsistence.'*

At this point, the natural relief would be found in emigration; but our author justly observes, that before men consented to leave the spot of their nativity, and to try their fortune by fresh cultivation, they would certainly argue, that what could not be possessed without a sacrifice, or obtained without labour, must belong to each person according to the labour he was able or willing to employ. At all events, this would be the case where emigration was difficult, or cut the new settlers off from free intercourse with the rest of the population. Perhaps, indeed, if bodily strength, mental ability, and industrious habits, were the same in each individual, and there were no difference in the amount of labour capable of being bestowed by each family, men might, under the circumstances I have mentioned, be induced to labour for a long time in common, and thus the division of property might be indefinitely retarded. But this is very far from being the case. In all the particulars I have detailed, one man differs materially from another. A sense of justice would therefore very soon suggest the propriety of an appropriation of the soil which had been cultivated by each family. They had bestowed a certain degree of labour and ingenuity upon that particular spot;—if more than others, it was reasonable that they should reap the fruit of their superior exertions; if less, it was unfair that their indolence or incapacity should cause others to suffer.

Here, then, is laid the foundation for a division of property in land, which is a sure, and indeed a necessary, step in the progress of agriculture. As long as men earn their subsistence by fishing or the chase, the division of property is neither so rapid nor so complete. These operations are best conducted by the combined labours of many, and the difference of bodily or mental powers may not perhaps be so directly felt to be a disadvantage; because, while the most active and

* Sumner on Creation, vol. ii. pp. 109, 110.

intelligent would naturally take the lead, there would be, in the various requisites of the combined efforts, a place to which the qualifications of almost every individual might be found suitable. What has been acquired by the united labours of a tribe, seems naturally to require equal distribution; and it will not be thought surprising, or contradictory of the observations already made, that, under these circumstances, some rude communities should exist, even in the present advanced state of the world, which still preserve their goods in communion, and have no accurate ideas of individual property. But this is never the case where agriculture has made any considerable advances. There the relative value of talent and industry, as well as of a numerous family, is easily appreciated; and hence the desire of appropriation.

A division of ranks naturally, and indeed necessarily, follows a division of property. Suppose the process begun, and it is easy to follow it out to this result. 'One man, whose strength and vigour enable him to prosecute his work unremittingly, prospers in his undertaking, and reclaims a quantity of land, not only sufficient to supply his own wants, but to afford an overplus. Even if his family increases, his children, as they grow up, add so much labour to the common stock, that the surplus above all their wants increases gradually with their strength and skill, till they are enabled to support a second family in addition to their own. In the natural course of things, however, others must prove less fortunate. One is cut off by sickness, and leaves his children dependant on the care of friends. Another is deprived, by some accident, of power to use his tools, till the season of cropping the ground is past. It follows that he must be fed by the more successful labour of his companions. But besides the operation of casualties, the effects of moral and mental distinctions must be taken into account. Some would be skilful and industrious, others the reverse. The one class would acquire what the others abandoned. The one would become rich and prosperous, while the other would become poor and dependant.

By these means a foundation would be laid for the distinction of society into employers and employed. The successful would increase in their desire for comforts and conveniences, as they increased in wealth; and commerce, taking its rise from this desire, would furnish them with the means of gratification. Hence would flow a demand for additional agricultural labour. Larger profits, and therefore more extended property, would be sought for. But the industry of a single family is necessarily limited; and, in order to cultivate a larger farm, the aid of others would be sought for. This aid would be found from among the poor and dependant class, who would readily be induced to give their labour for the means of subsistence. Here we find, by an obvious and inevitable process, the distinction of ranks established. Examples of this process are constantly to be found in the history of the early stages of society. A striking instance of this occurs in Roman history. Not only were the inhabitants of Rome reduced to an equality by an Agrarian law, which awarded an equal division of territory to each individual, but such laws were enacted by Romulus and his successors, as tended to perpetuate this equality as far as human regulations could restrain the natural current of events. Yet this unnatural state of things was of short duration. 'The course of human affairs,' says Adam Smith, 'by marriage, by succession, and by alienation, necessarily deranged this original division, and threw the lands, which had been allotted for the maintenance of many different families, into the possession of a single person.'* This was the case with many other of the ancient republics, where similar laws were established. The natural tendency to inequality broke through all the restraints of human arrangements, and, in spite of them, produced those salutary distinctions on which the fabric of society is reared.

'The Deity has provided,' says Sumner, 'that, by the operation of an instinctive principle in our nature, the human race should be uniformly brought into a station in which they are forced to exert and to improve their powers; the lowest

* Smith's Wealth of Nations, vol. ii.

rank to obtain support, the one next in order to escape from the difficulties immediately beneath it; and all the classes upwards, either to keep their level, while they are pressed on each side by rival industry, or to raise themselves above the standard of their birth by useful exertions of their activity, or by successful cultivation of their natural powers. If, indeed, it were possible, that the stimulus arising from this principle were suddenly removed, it is not easy to determine what life would be, except a dreary blank, or the world, except an uncultivated waste.'*

EIGHTH WEEK—THURSDAY.

EFFECTS OF PROPERTY IN THE SOIL.

THERE are some social arrangements so intimately connected with the moral constitution of man, that they invariably attend the progress of civilization, being at once the natural effect of that progress, and a necessary step to further advancement. Of these, none perhaps is more remarkable than the acquisition of property in the soil. I have already shortly adverted to the principles of our nature, which lead to this appropriation.† What I have to remark at present is, that, without this propensity to take possession of the soil, accompanied as it is by a natural feeling which concedes the right of possession to him who has actually obtained it, man must, in all probability, have remained in a rude and unimproved state, and the earth uncultivated and waste, would have denied the abundant harvests, on which not merely the prosperity, but the very existence, of civilized society depends.

As soon as the soil has begun to be cultivated, it becomes, as I have stated, by that very operation, the property of indi

* Sumner on Creation, vol. ii. p. 132.

† If the reader desires to prosecute this inquiry, he would do well to consult Dr. Chalmers' Bridgewater Treatise, chap. vi. 'On those special affections which conduce to the civil and political well-being of society.'

viduals; because the pains which have been bestowed by these individuals in preparing it, stamp a certain value on it which it did not previously possess. It has, by their industry, been cleared of bushes, roots, and other incumbrances, perhaps freed of its superfluous moisture by draining, and defended from encroachment by enclosure. All these circumstances, not to mention the single circumstance of occupation, which is itself sufficient, constitute a right to the soil felt by the individual, and respected by neighbours. On this principle the law of property is founded, and that law forms the strong bond of society, and may be said to be the starting point for the prosperity of nations. It is by the operation of this law, that agriculture is converted into a regular system, and becomes an art of such essential importance to the welfare of society. Were it not for the appropriation and subdivision of the land, the whole face of the country would remain nearly in its natural condition—as is still the case among those savage tribes where civilization has not yet penetrated—and the means of support for human beings would have been comparatively scanty. Among some tribes of North American Indians, and in various parts of Africa, and especially among the aborigines of Australia, the effects of this state of things are obvious. The human inhabitants, ignorant and barbarous, are thinly scattered over large extents of country, which are naturally fertile perhaps, but almost destitute of vegetable productions fit for the use of man. Pulse of every species is rare; there are few esculent roots, and no grain. Contrast with this, the appearance and resources of such parts of these very regions as have become the habitation of civilized man. There the land, having become private property, has been subjected to the transforming influence of cultivation, and instead of yielding food almost exclusively for the inferior creation, has become a granary for the support of rational beings; the consequence of which is, that while the human species, living in abundance, and cultivating the peaceful arts, are rapidly increased in numbers, and improved in their intellectual powers, the very beasts of the field receive important

benefits, from what might, in one view, be considered as an usurpation on their native domain.

A still more striking evidence, perhaps, of the salutary effect produced by the appropriation and consequent cultivation of the soil, may be found by seeking for it in those countries which formed the early seat of agriculture, but have since been abandoned through the agency of a grinding despotism. The whole extent of the Turkish dominions, especially in Asia, at this day, exhibits a melancholy and instructive example of this kind.*

Now, the lesson which I am anxious to inculcate on my readers from all this detail, is, that there is a remarkable correspondence between the constitution of external nature in these respects, and the moral constitution of man, exhibiting the clearest indications of beneficent design in Him who is the author of both. If the earth requires to be cultivated, before it gives forth its supplies, in great abundance, for human support, there are principles in the mind of man, which are obviously intended to inspire him with a predilection for agricultural employments, which protect and encourage him in the exercise of these employments, and which render that exercise not less salutary to his moral and intellectual faculties, than it is invigorating to the powers of his body. Or, to take the converse of the proposition, if man is naturally endowed with mental qualities, which require to be roused by difficulties, and called into vigorous action by some powerful necessity, then the state of external nature, in reference to the produce of the soil, is precisely such as to present these very difficulties, and to stimulate the mind with a sense of that very necessity. In whichever way we view the subject, it is impossible not to perceive, that a wise Creator has adapted man to his circumstances, and these circumstances to the benefit of man.

* Keith on Fulfilled Prophecy.

EIGHTH WEEK—FRIDAY.

BENEFITS DERIVED FROM THE PRINCIPLES WHICH STIMULATE AGRICULTURAL IMPROVEMENT.

THERE can be no doubt, that in the progress of society, the principle of which we have been considering, a vast change takes place in the various relations of life; but it has been a matter of dispute, how far that change has, upon the whole, been salutary; or, at least, whether or not it will, in the last result, prove to be so. It has been alleged, that, 'if the rapid multiplication of the species augments the treasures of civilized society, it also entails upon civilization a certain inheritance of want, and pain, and misery, and that the human race are little benefited by arts and improvements, which are wrung from them by the urgency of their necessities; that, however plain it may be made, that the means employed accomplish their apparent object, still it is by a mode so harsh and ungentle in its operation, that the wisdom of the Creator is impeached, rather than displayed, when the intricate web of human society is thus unfolded, and its texture unravelled.'

That the reader may be furnished with a proper answer to these plausible objections, he must keep steadily in view the principles already laid down for judging of the operations of Providence. This world is not a state of happiness, but of discipline; both its moral and physical condition is fallen and debased, by the alienation of man from his Creator. All its adaptations, contrivances, and processes, must therefore be viewed with reference to this state. We are not to look for perfection, but for plans and operations, suited to lead a fallen and guilty creature to the attainment of it—not for a full development of the Creator's designs, but a partial view of the commencement of an amazing scheme, which has eternity for its theatre of action.

'If we were peopling an Utopia,' says Bishop Sumner, 'or amusing our fancy, after the manner of the ancient philoso-

phers, with creating an imaginary republic, we should undoubtedly be inclined to banish from it all necessity for severe labour. We should omit the curse denounced upon the first transgressors, and literally fulfilled upon their posterity, ordaining that the earth should bring forth thorns and thistles, and that man should eat bread by the sweat of his brow. But these sports of imagination deviate from the real state of things in one most important particular. They all suppose, that this world is the final object, as well as the limit, of man's existence.'

However beautiful such views might be, as they do not exhibit the condition of man in his present state, they ought not to be taken as the rule by which we judge of the adaptation of the material world. Taking man as he is, I have already shown how a state of labour—of even severe coercion to labour—is suited to call into action his latent faculties. I am far from pretending to say, that no evils accompany the law which binds him to this state. I know, on the contrary, that there are numerous evils arising from the wealth, as well as the poverty, to which it gives rise. But then these evils are much more than compensated by the advantages which flow from the system. It is not difficult to suppose a state of things in which plenty should constantly attend the human race, however numerous they might become, or in which the numbers of mankind should be always, without any restraint or privation on their part, exactly proportioned to the means of subsistence. But, on either of these suppositions, the stimulus to exertion would be gone ; and that indolence, which belongs to the species, and is only removed by necessity, would repress and overpower the human faculties.*

It is as possible to picture to the imagination a race of men, who should require no stimulus to the exercise of their minds and powers, as it is to conceive a soil that should be fertile without cultivation. But our business is with the world as it exists, and with men as we find them ; and, judging accord-

* Bishop Sumner refers to Humboldt, and other travellers, for proofs of this deterioration among the indigenous inhabitants of North America.

ing to that experience, we may affirm, without hesitation, that any ordinance which would establish universal plenty, would establish also universal indolence, and not only arrest civilization in its progress, but force it to retrograde, if it had once advanced. There is reason to believe, that this effect has in some peculiar circumstances, actually taken place, when a few tribes, having left their parent and overpeopled country, and found an unexpected plenty in some new abode, have lived upon that plenty, till they have lost the arts of their ancestors, and left their posterity to work out anew, by the slow method of invention, the means of supplying wants or providing comforts.* How soon rude inventions may be lost, when the necessity which first struck them out is removed, may be learned from the example of the South Sea Islanders, some of whom are now in greater distress from the precarious supply of iron they depend upon, than, before the visits of the Europeans, they had experienced from the total want of it. Be this, however, as it may, it is certain that the effect of plenty on savage nations is indolence and extravagance, till the supply that brought the evil is exhausted, and activity returns with the necessity for its exertion.

'All mankind, as far as we know, agree in the same properties by nature, and owe their infinite varieties only to the circumstances of society. We have no right, therefore, to as-

* Proofs of the natural indolence of the human species might be multiplied to any extent. A single example may be taken from the inhabitants of one of the South Sea Islands, as mentioned by Mr. Ellis. The Otaheitans, whose country, from various known circumstances, which I need not stop to mention, is not at present peopled up to its natural resources, refuse to cultivate the valuable arrow-root, because it costs them some trouble in rendering it fit for food. Their yam, also, 'a most valuable root, is cultivated to no very great extent, from the labour and attention it requires, although it is one of the best flavoured and most nutritive roots.' 'When they were exhorted to adopt the comforts of Europeans, they answered—"We should like these things very well, but we cannot have them without working: *that* we do not like, and therefore would rather do without them. The bananas and plantains ripen on the trees: the pigs fatten on the fruits that fall beneath them. These are all we want. Why, therefore, should we work?"'—Ellis' *Polynesian Researches*, vol. i. pp. 360, 541.

sume, that the consequences of plenty would be different in America and in Europe; or that, if the necessity which has produced all the multiplied inventions and ornaments of civilized life were once removed, the faculty to suggest them would be fostered, or the industry to perfect them survived. But who would be so visionary as to affirm, that the comfort of society would be benefited by a system, which excluded all the useful and ingenious arts; or the general good of mankind promoted by the extinction of all the liberal professions, —the absence of all science and literature? Independence would be dearly purchased at the expense of refinement and cultivation; and universal plenty would afford a poor compensation for the gross ignorance into which mankind would be plunged.'*

EIGHTH WEEK—SATURDAY.

THE BLESSINGS OF LABOUR.†

INDEPENDENTLY of the declarations of Scripture, a moment's serious reflection is sufficient to convince us of the admirable and merciful adaptation of the laws of the earth's productiveness to the moral and intellectual state of man. Were the sky ever serene, and the air ever warm and genial; were the fierce extremes of heat and cold unknown; and were every species of fruit spontaneously scattered over the earth, in exhaustless profusion, the physical wants of our race might be adequately supplied, and the world might be peopled with millions of human beings, enjoying in abundance the means

* Sumner on Creation, vol. ii. pp. 146, 147.

† These additional observations on the paternal kindness of those providential arrangements by which laborious exertion is rendered necessary to man, in procuring the means of subsistence, are furnished by the ingenious friend, to whom I am indebted for several other papers with the same signature. Some of the views already stated, will be here found repeated in a new train of thought. They will not, however, be felt to be misplaced; and they are too important to render such a repetition unedifying.

of appeasing their hunger and thirst. And were these beings possessed of a sinless nature, they might, indeed, consecrate their calm and undistracted days to the high pursuits of science and religion, and might attain to heights of contemplation and social joy hitherto wholly unexperienced. But let us only consider the moral state of the race with which the earth is at present peopled, their evil passions, their love of inaction, and the corrupting tendency of indolence,—and we shall learn to prize and bless that arrangement by which labour is made the condition of subsistence, and all true enjoyment. Were the pressing wants of man supplied without cost or industry, what motive could prompt him to exertion, and raise him above the condition of the brutes? His food being plentifully supplied him, and clothing and shelter being almost unnecessary, would he not be contented to pass his life in slothful inactivity, or in wanton acts of mischief and violence? Indeed, seeing it is the present tendency of ease and luxury, even though checked by the most powerful religious and social restraints, to generate a spirit of selfishness and moral abandonment, may we not conclude that man, if labour and all its consequences were unknown, would only revel in the grossest indulgence, forget the Hand that fed him, and feel no desire to cultivate the moral and intellectual capacities of his nature?

In countries where a rich soil and a powerful tropical climate produce almost spontaneously the means of subsistence, civilization, and all the refining arts of life, are in the lowest condition. Man is there unacquainted with peaceful industry, and but too frequently seeks plunder or excitement in war or the chase, or, at best, resigns himself to a savage indolence. In countries, again, where nature is less exuberant, where the soil requires cultivation to enable it to support its possessors, and the climate renders artificial shelter and clothing a necessary of life, society readily flourishes, and agriculture and the useful arts give birth to commerce with all its blessings. There spring up literature, science, and the various branches of civil polity, the last and best results of human

labour. Thus, in Europe, and in several of the more temperate regions of Asia, has our race made the greatest progress in the career of social improvement. There have been achieved the mightiest deeds in the pursuits of war and peace; for there they have been driven into industry. They have become the noblest portion of mankind, because they have been constrained to be the most laborious.

To what but the necessity of procuring shelter and subsistence, do the arts of life, under Divine Providence, owe their origin? What else gave rise to agriculture, and all its subsidiary arts?—induced man to sink the mine, and to fuse and fashion the precious metals?—produced the daring efforts of architecture, and the beauteous wonders of the loom? What but the cravings of his physical wants prompted him to cross the dangerous deep, and effect an interchange of products between the most distant lands? But for these wants, he would have been content to vegetate upon his native spot, local attachment prevailing over the promptings of curiosity itself. The sea, therefore, the best highway between remote countries, would have remained untraversed; and the earth's utmost shores would only have been visited slowly, and after the lapse of ages, by tribes of men gradually propelled from the original centre of population. Thus, the advantages of navigation and commerce would have been altogether unknown. Had not labour been imposed upon man, how could those sciences have arisen that give him such a mastery over brute matter, and reveal to him so many secrets of Nature? Without the glass that he employs to admit the light into his roofed abode, fashioned by his skill into the prism, how could he have unravelled the solar beam, and explained the brilliant phenomena of colour? Or, without that same beautiful result of his labour, taking under his plastic hand another form, where would have been that sublime astronomy which unveils to him the glories of the universe, and exalts him, as it were, above his natural destiny?

Such are the thoughts that occur at this busy season, when the farmer and his labourers are so actively engaged in pre-

paring the soil, and committing to it the precious seed. All the land is now ringing with the sound of rustic toil. The sower follows hard upon the ploughman, and is, in his turn, closely approached by the harrower. The carefully hoarded manure is carried out in carts and waggons, and scattered over the fields, where, by the kind agencies of Nature, it is destined to increase tenfold the treasures of the coming harvest. Severe and unremitting are the fatigues of the husbandman and daily labourer, engaged as they are in a continual warfare with the sturbbornness of the soil, and the various inclemencies of the season. But the sweat wrung from their brow sweetens their enjoyments; after labour, comes to them the luxury of rest; and health and cheerfulness are among the fruits of their hardy occupations. They find a pleasure in active employment; so that spring and harvest, when their labours are most continued and severe, are the seasons of their highest excitement. Even to those who are not dependant for support on the work of their hands, the spectacle of the present agricultural operations must surely be highly animating. For, can it fail to occur, that on these depends the future support of the rich and the poor, and that, indeed, on agriculture is based the entire fabric of human civilization? And when we behold the sons of labour plying their vocations in the field, whether or not it be our lot to mingle in their toil, can we fail to admire the wide expanse of valley and plain, smiling with green blades or ripened ears, the rich reward of their diligence, and to reflect that, but for cultivation and its cares, the country would be a pestilential forest or marsh,—the extremes of heat and cold would be fatally severe,—and, a still greater evil, man would be plunged in ignorance and sloth, if not also pinched by a scanty and precarious subsistence? We are thus forced to exclaim, with the bard of the Seasons,—

> 'These are thy blessings, Industry! rough power!
> Whom labour still attends, and sweat and pain;
> Yet the kind source of every gentle art,
> And all the soft civility of life.'

Even in his state of innocence, man was not without his labour. Adam had assiduously to cultivate his happy and beautiful abode; which shows that his Creator formed him for action as well as contemplation, and that industry was essential to his highest happiness. In the emphatic words of our great poet,—

> 'Man hath his daily work of body or mind
> Appointed, which declares his dignity,
> And the regard of Heaven on all his ways.'

J. D.

NINTH WEEK—SUNDAY.

SPIRITUAL TRAINING BY AFFLICTION.

The principle, as we have seen, by which we are so remarkably urged forward in the path of improvement, is privation. This implies suffering; and, in fact, the fear of suffering on the one hand, and the hope of enjoyment on the other, are two of the strongest motives of human conduct. Such is obviously not a state of perfection, but of discipline; and every thing, in the various providential arrangements of the world, strikingly corresponds to this condition. We are under training for eternity; and this is the important view in which we are taught, by the Gospel, to consider all the events of life. While we painfully labour for the food which perishes, we are reminded by the voice of Revelation, that there is a food which endures to everlasting life, for the attainment of which, we ought, above all things, to exert our rational powers. To lead us on this path of duty, Divine Providence is constantly employed. Hence God is very frequently represented in Scripture under the character of a Father and Instructor. We hear of his rod of correction; of his profitable chastisements; of the heart being made better by the sadness of the countenance. The same thing is taught when Christ

is exhibited to us under the character of a physician. He gives us bitter medicine, that he may cure us. He probes the wound, that he may heal it.

It is delightful to dwell on this view of our God and Saviour. Nothing can be more endearing than the assurance that we are the objects of his constant regard,—that he numbers the hairs of our head, and counts our tears, and that all things are working together for our good. What a different character do privation and suffering assume when viewed in this light. From curses they are converted into blessings. When we think of 'the light affliction of the present moment, working out a far more exceeding, even an eternal weight of glory,' we cease to complain,—we learn even to rejoice in our afflictions. It was this which sustained the apostles, the martyrs, and the confessors of our holy religion, —which made them 'more than conquerors,' and which enabled them triumphantly to exclaim,—'We are troubled on every side, yet not distressed; we are perplexed, but not in despair; persecuted, but not forsaken; cast down, but not destroyed:' 'Neither death, nor life, nor angels, nor principalities, nor powers, nor things present, nor things to come, shall be able to separate us from the love of God which is in Christ Jesus our Lord.'

But this view is not less instructive than it is delightful. Is God our Father? Then, if He teaches, we must learn: if He gives warning, we must listen: if He chastises, we must be corrected. Is He our physician? Then, if He administers medicine, however bitter and nauseous, ought we not cheerfully to drink the cup to the very dregs? If, to heal us, he probes our wounds to the quick, ought we not, without shrinking,—nay, thankfully, to submit?

The afflictions to which the providence of God is pleased to subject us in this sublunary state, are various and severe. He at one time tries us by withdrawing some cherished enjoyment; at another, by inflicting some positive suffering. Our hopes may be disappointed; our worldly affairs may become embarrassed; our friends may prove unfaithful; our

children undutiful or profligate; sickness may invade the family circle; death may sever the dearest ties which bind us to life. These are distressing dispensations; but who will say that, if received in a right spirit, they are not salutary? Alas! we make idols to ourselves of earthly things; prosperity withdraws our hearts from God; and is it not well that He should deprive us of that which betrays us? What if it were otherwise?—if God, in just indignation, ceased to chastise us?—if the sentence pronounced upon Ephraim were uttered against us, 'They are joined to their idols, let them alone?' But it is not so. God still trains us as his children; when we are afflicted, it is the hand of a Father which corrects us. When he hides his face, it is in mercy. He waits to be gracious.

God deals with us in spiritual, as He does in temporal things; and here, too, his mode of acting is frequently beyond our power to unravel. He bestows and withholds the blessings of his grace, often in a manner, and for reasons, that baffle human judgment. In all his actings, He is, doubtless, guided by unerring wisdom and goodness; but to us it appears as if the sunshine and the cloud in the spiritual atmosphere, were as fitful and capricious as seem to be the analogous changes in the natural atmosphere. Both are regulated by a will, which, on account of its infinite superiority to ours, we cannot follow in all its plans; but which never fails to effect the most beneficent purposes. When the snow lies on the ground, and all things wear the aspect of desolation and death, the germs of future vegetation are preparing to be unfolded, and the insect race are lying cradled in their snug retreats, to rise to life in the genial heat of returning spring. In the advancing year, when, at times, the smiles of a warmer sun are withdrawn, and the fair face of day is shrouded in clouds and tempests, there is still a secret hand at work, 'staying the rough wind in the day of the east wind,' and leading the seasons onward in their steady course. And so it is with the operations of divine grace. The light of religion may seem to be withdrawn, for ages, from whole districts and

countries, nay, almost from the world, and a cold and cheerless winter may appear to envelope all; yet still the germ of life is there, and life itself. In times of Israel's greatest defection, when the prophet thought he stood alone in his faithfulness, God re-assured him with the declaration, that he had yet reserved to himself, in that apparently dark and lifeless land, seven thousand persons who had not bowed the knee to Baal. Again, when the light of the Gospel has begun to shine brightly on a favoured spot, and the spring of a spiritual year seems to be vivifying the divine seed far and wide, and causing a dead soil to start into life and beauty, there often comes a fierce and chilling blast, which appears to bring back gloom, blight, and ruin, to an awakening world. But here, too, there is mercy mingled with judgment; the warmth, which seems to have abandoned the atmosphere, still lingers in the ground; the rays of the Sun of Righteousness have penetrated too deep to have their influence extinguished by a passing tempest; the storm has raged, and the gloom has lowered, but, meanwhile, the rain of heaven has moistened the earth; and, when the jarring elements have expanded their fury, thousands of plants open their bosoms to the genial influence, and find the air more pure and balmy, and the sky more bright and serene.

Yes! He, who searches the heart, knows his own people. The Holy Spirit is never absent, though his operations are not always visible to our feeble and jaundiced eyes. 'The wind bloweth where it listeth, and thou hearest the sound thereof, but thou canst not tell whence it cometh, and whither it goeth: so is every one that is born of the Spirit.' There is a sovereignty in divine grace, which mocks human research; yet never does the secret aspiration of the pious soul escape the ear of the Saviour, or fail to bring down an answer of peace. I know not if there be any thing more encouraging to the affectionate but doubting heart, in all the gracious declarations of our Lord, than that simple but soul-moving answer, by which he satisfied the anxiety of the guileless Nathaniel, 'Before Philip called thee, when thou wast under

the fig-tree, I saw thee.' To know that we are always the objects of Divine care; that there is an unseen eye ever watching over us for good, a secret ear listening to our deep-breathed prayers, a silent hand bringing good out of seeming evil, and causing even sorrow and suffering, sickness, and death itself, to promote our eternal interests,—this is peace! this is triumph!—a peace which passeth understanding—a triumph which is a foretaste of celestial joy.

NINTH WEEK—MONDAY.

NATURE OF SOILS.

I HAVE already cursorily adverted to the nature of the soil, and its general diffusion over the surface of the earth. I have also noticed the natural distribution of plants, and some of the remarkable properties with which they are endowed, so as to preserve a salutary balance between those which are more and those which are less useful, in reference to animal life. Were this arrangement perfect, there would remain nothing for man to do as a cultivator of the soil; but, although the general tendency is clearly towards perfection, yet in this, as well as in other particulars, there is obvious and intentional imperfection mingled with it. It is, without doubt, part of the plan of Creative Intelligence, that the arrangement should be so left as to admit of the beneficial interference of man, and to enable him to adapt it to his own advantage and convenience. This is true both with regard to the nature of the soil, and the properties of plants; and it will now be my pleasing task to point out some of the qualities and adaptations by which the former invites and rewards cultivation, and the latter, under the care and skill of rational beings, are rendered more subservient to use or enjoyment.

1. With regard to *soil.* The surface of the earth is composed of ingredients which are more or less prolific, according to their nature, and the proportions in which they are inter-

mixed. There is, first of all, simple earth, a substance which, when analysed, is found to be nothing more than abraded and disintegrated rock. It is not of itself prolific, or, at least, is so, only in a very slight degree, and indeed is considered by most physiologists as of no other use to plants than that of supporting them, or furnishing a medium by which they may fix themselves to the globe. Some earthy ingredients, indeed, are found in all plants, but they undergo no chemical change, and cannot properly be said to be the food of vegetables. The true nourishment of plants is water and decomposing organic matter, and these must be mixed in certain proportions with pure earth, so as to constitute soil. This is one principle on which the power of man, in rendering the soil fertile, is found to rest. He may by various processes—by mixing, for instance, with the land some vegetable or animal matter in a state of decay, where this constituent is deficient, or by adding earthy materials where this happens to be redundant; by loosening it with agricultural instruments, and thus subjecting it to the influence of water, when its indurated state prevents that necessary element from penetrating; or by draining it, and thus withdrawing a superabundant supply of moisture:—by any one of these means he may ameliorate the soil, and render it fertile, when it would otherwise be barren, or increase its prolific qualities when they do not yield a sufficient return.

Again, the mere mixture of ingredients already existing in a soil, and exposure to the atmosphere, are found to produce a beneficial result, by promoting fermentation, and by subjecting them to the influences of the sun and the air. Here, again, man has the means of increasing the prolific quality of the soil, and of rendering it more fit for his use.

These, and various other operations, are rendered important by the actual state of soils over the surface of the earth. In a great majority of instances, the land is not in such a highly prolific state as to be incapable of improvement by judicious management; and even where it is composed of ingredients mingled in the greatest perfection, and in the most beneficia

proportions, it becomes deteriorated by use, so as to require constant attention. Such an arrangement is best fitted for the present condition of the human race. There is here something calculated to stimulate industry and ingenuity, by holding out the prospect of advantage.

Nor must it be forgotten, that the various materials necessary for the amelioration of the soil, are very generally within reach; and that the operations by which these materials may be rendered available, are in themselves sufficiently simple, and require instruments by no means complicated. Were it otherwise, the condition would be unsuitable to the circumstances of man, except when considerably advanced in civilization; and obstacles would be interposed, at the very outset, which might prove fatal to his improvement, not only in this but in other respects. Let us suppose, for a moment, what would be the consequence to agricultural progress, in its earlier stages, if the only method of improving the soil, were by excavating manure, for example, from the hard rock, as is the case in the application of lime, and causing it to undergo decomposition by fire. Such an operation would obviously be too recondite to be discovered by man in an uncivilized state, and too difficult and complicated to be generally reduced to practice. But the ordinary means by which the soil is improved, are readily at hand, and are too obvious not to be discovered in the natural course of things, without scientific knowledge, or more skill than is acquired by man in a very early stage of society. As soon as he has begun to turn up the earth, he discovers that the vegetables with which its surface was covered, fertilize the soil as they decay; the dung accidentally dropped, he observes to give peculiar vigour to the vegetation in those places where it has been covered in; the land he finds to be better adapted to the growth of plants, when cleaned of weeds, and pulverized; too much and too little moisture he discovers to be equally injurious. It is thus that, in a short time, and with the simple exercise of a little observation, the great and leading principles of agriculture are unfolded, and the soil yields its powers to man, without the aid of science.

The importance of all this facility will appear more clearly, when we consider how much of human improvement and happiness depends on the resources of agriculture. It is from this employment, indeed, that the advancement of society in the arts and sciences may be considered as mainly taking its origin. While men gain their subsistence by hunting or fishing, they are always in a savage state, having seldom any fixed habitations, but roaming through the forests, or frequenting the sea-coasts or the banks of rivers, wherever their means of subsistence in the various seasons of the year may be found most abundant. The shepherd state, indeed, implies considerable advancement beyond that which we have mentioned. It supposes the recognition of personal property, and sometimes also, but by no means generally, a settlement in a particular locality, and the possession of a few domestic comforts. But it is not till man has advanced a step further, and has begun to cultivate the soil, that he makes any very important progress in civilization, or becomes bound permanently with his fellows in the bands of a well-organized community. It may, therefore, be regarded as a proof of wise and beneficent arrangement, not only that the soil requires, and rewards cultivation, but also that the means by which that cultivation may be effected are so easy of access, and so patent to general observation.

NINTH WEEK—TUESDAY.

FORMATION OF SOILS.

I HAVE observed, that the simple earths are produced by the decomposition of rocks, and it may be proper to show how this process takes place. This I shall do in the words of Sir Humphrey Davy, who has expressed himself with much philosophical precision, and, notwithstanding the scientific terms he employs, with sufficient plainness to make his general meaning understood by an unscientific reader. 'The manner in which rocks are converted into soils, may be easily

conceived, by referring to the instance of soft granite. This substance consists of three ingredients, quartz, feldspar, and mica. The quartz is almost pure silicious earth, in a crystalline form. The feldspar and mica are very compounded substances, but contain silica, alumina, and oxide of iron. In the feldspar there is usually lime and potassa; in the mica, lime and magnesia. When a granitic rock of this kind has been long exposed to the influence of air and water, the lime and the potassa contained in its constituent parts, are acted upon by water or carbonic acid, and the oxide of iron, which is almost always in its least oxidized state, tends to combine with more oxygen. The consequence is, that the feldspar decomposes, and likewise the mica, but the first the most rapidly. The feldspar, which is, as it were, the cement of the stone, forms a fine clay; the mica, partially decomposed, mixes with it as sand; and the undecomposed quartz appears as gravel, or sand of different degrees of fineness. As soon as the smallest layer of earth is formed on the surface of a rock, the seeds of lichens, mosses, and other imperfect vege tables, which are constantly floating in the atmosphere, and which have made it their resting-place, begin to vegetate Their death, decomposition, and decay, afford a certain quan tity of organizable matter, which mixes with the earthy materials of the rock; in this improved soil, more perfect plants are capable of subsisting. These, in their turn, absorb nourishment from water and the atmosphere, and, after perishing, afford new materials to those already provided. The decom position of the rock still continues; and at length, by slow and gradual processes, a soil is formed, in which even forest trees can fix their roots, and which is fitted to reward the labours of the cultivator.'*

To this account I may add that of Dr. Sigmond, who thus clearly and elegantly describes the process by which a vegetable soil is gradually formed:—'First, upon the burning sand, or naked rock, the simplest structure of vegetable life, the lichen, almost invisible to the eye, fixes itself, blown pos-

* Elements of Agricultural Chemistry, p. 188.

sibly by the breeze. Its generation is scarcely understood,—it boasts no flowers which require time for their development, or food for their secretion. They struggle through their ephemeral existence, either upon the confines of eternal snow, or upon the scorching regions of the torrid zone; they fulfil the general law of nature—they die; but in their death they are the harbingers of life: They decompose; the particles of which they are formed unite with the oxygen of the air; an acid is the result, which eats its way into the crevices of the rocks, or insinuates itself amid the sand, when its other particles form new combinations, and, burying themselves, become a first layer of vegetable mould; cracks and crevices thus are formed, in which moisture is deposited; these become enlarged, either by the expansion produced by heat, or by frost; the granite mass is burst asunder, or slow disintegration occurs. In the thin stratum of mould a tribe, a little higher in the scale of vegetable life, is developed, probably some elegantly-formed moss, which bears a miniature resemblance to trees and shrubs; these, too, run through their destined course; they die, and leave behind their remains, for the birth-place of some more perfect plants, such as the grasses, the saxifrages, the wormwoods, and plants with small leaves and low slender stems. The vegetable mould now deepens; generation succeeds to generation; plants of a more complex structure, and of a higher stature, such as shrubs and bushes, begin to rise upon the rock, or the sand, now no longer an inhospitable mass; at last the loftiest monarchs of the forest are developed, and spread over an immense surface, for perchance a single seed, wafted by wind, borne by some bird, washed by some flood, or swallowed by some animal, and thus prepared for germination, is the means by which the new generation bursts into birth, and changes the face of nature. There is an uninterrupted circle of events on which the preservation and the gradual improvement of all the productions of nature hangs, and there is an endless source of inquiry for man.'*

The processes here described are such as are at this mo-

* The Lancet.

ment proceeding on the surface of the earth. But they do not of themselves account for the phenomena which the surface of the earth at present displays. If the reader has at all attended to what has been said in the 'Winter' volume, respecting geological changes and revolutions, he will understand in what manner these operations may have been accelerated, and the various soils, thus formed, may have been removed and mixed. The hand of the great Creator is as conspicuous in the one class of operations as in the other; and while we trace these operations, we should never lose sight of Him, who not only at first endowed matter with such tendencies, but who afterwards presided over and controlled all its convulsions, so as to fulfil his high behests, and finally, to produce a world so admirably fitted for the habitation of a race of rational beings, such as man.

Peaty soils are produced by very different causes from those already mentioned. They arise from the accumulation of neglected vegetable matter in moist situations. Where successive generations of vegetables have grown upon a soil, Sir H. Davy observes, unless part of their produce has been carried off by man, or consumed by animals, the vegetable matter increases in such a proportion that the soil approaches to a peat in its nature; and, if it happen to be in a situation where it can receive water from a higher district, it becomes spongy and permeated by that fluid, and is generally rendered incapable of supporting the nobler class of vegetables. Another mode in which peat has been formed, is by the gradual accumulation and decomposition of aquatic plants in shallow lakes and stagnant pools. This kind of peat is of a more loose and spongy quality, and the fermentation which takes place seems to be of a different kind, more gaseous matter being evolved. What has greatly contributed to the growth of peat is the destruction of ancient forests, either by the operation of some natural cause, or by the hand of man. In Britain, and various parts of the European continent, the conquests of the Romans seem greatly to have contributed to this. That adventurous and warlike people, found it neces-

sary, for the evolutions of their armies, to destroy the extensive woods which formed the natural fastnesses of the inhabitants; and, having accomplished this object by fire or by other means, they suffered the unconsumed trees to lie where they fell; and these, where the ground was level, damming up the little brooks and rills, and causing the moisture to accumulate, gave rise to a coarse vegetation, which, in process of time, formed into extensive morasses. The existence of great quantities of wood, in various stages of decomposition, having sometimes very obviously undergone the action of fire, sometimes of the hatchet, in almost all the mosses of this country, may readily be accounted for on this supposition.

It is instructive to observe, in the management of soils, a principle not yet adverted to, but brought into view by this account of the origin of peat-bogs and mosses. Land, as appears by this example, is capable of deterioration by neglect or abuse, as well as of improvement by cultivation. The peaty soil of Great Britain and Ireland, and, indeed, it has been alleged, of the habitable globe, constitutes nearly one-fourth of the whole surface. This ungenial soil is constantly on the increase, wherever it is not arrested in its progress by human industry. Here, then, we have a stimulus to exertion, the converse of that previously mentioned. The former holds out a reward to industry, the latter acts as a punishment upon negligence and sloth. This is entirely in conformity with the operations of Providence in other respects, and indeed, in various modes, enters in to all the operations of agriculture. While judicious management never fails to repay the active and intelligent cultivat or by an improved soil and a liberal return, the slothful and foolish find, to their cost, that the ground cannot be neglected or abused with impunity. The field of the sluggard is quickly filled with noxious weeds, which encumber the soil and destroy the useful plants intended to be produced. Excessive or unskilful cropping reduces the soil to barrenness. In either case, the earth resents, as it were, the treatment she receives, and refuses to give forth her fertility.—Such is the wise decree of the Most High.

NINTH WEEK—WEDNESDAY.

MANAGEMENT OF SOILS.

From what has been already said, it appears, that the constituent elements of soil, as regards their general chemical properties, are very simple. There are, however, various modifications of these elements, which render the subject somewhat more complicated than it might at first sight appear. Not only are the ingredients mingled in very different proportions, but, by their chemical combinations, their appearance and properties are altered, so as to constitute soils of very different quality. All these circumstances give rise to the necessity of varied management, and a variety of agricultural implements, which increase in number and perfection in proportion as the science is better understood. In treating of this subject, with reference to the manner in which these arrangements are adapted, by Creative Wisdon, to the condition and powers of human beings, it is evident, that it will be necessary to confine ourselves to a consideration of the broad and general features which it exhibits.

British soils may, in this view, be arranged into four different classes, according to the ingredient most predominant in each, whether clay, sand, gravel, or moss. Each of these requires a different mode of cultivation. A clay soil, in whatever way it may be distinguished—by its colour of black, white, yellow, or red—differs from all other soils, by being tough, wet, and cold. It holds water like a cup, and, consequently, when once wetted, does not soon dry; and, on the other hand, when once dry, is not soon saturated with moisture. In a summer without rain, the surface is covered with chinks or cracks, and is, in this way, prepared by the hand of Nature for receiving the water when it falls. In this latter state, when ploughed, it is found to be hard and cloddy, and not easily pulverized by labour; and if, on the other hand, it be ploughed when full of moisture, it sticks to the plough like mortar.

This description shows the difficulties with which the agriculturist has to contend, when such soil is subjected to his management. He must employ his art in rendering it less adhesive, both that it may become more pervious to moisture, and better fitted to admit the free insertion of the rooty fibres of the plants sown upon it. This he may effect in various ways. Top-dressings of other kinds of soil, a liberal use of lime, frequent ploughing, considerable quantities of manure, are among the means usually employed in such a case, and not employed in vain. By such means, the stiffest and most unproductive clay can be converted into a rich loam, which bountifully rewards the skill and labour bestowed on it.

Sandy soils are of a very different nature, and are subject to defects of an opposite description. When there is little foreign admixture in this kind of soil, it is light and barren, and requires a considerable addition of other earths to render it fruitful. It is, under all circumstances, loose and crumbling, and is not susceptible of equal improvement with the land already described. In dry weather, the moisture, having rapidly escaped, both by evaporation and filtration, leaves the soil without a sufficient quantity of nutritive juices to bring the plants to perfection, and thus the crops must be always comparatively precarious. Much, however, may be done to counteract this defect; a remarkable instance of which is presented to us in the agriculture of Norfolk. Nearly one-half of the lands of that country were little better than a barren waste. But a judicious system of management was adopted:—By a liberal use of clay and marl, and common manure, during a considerable period, a new soil may be almost said to have been created; and, when a crop of clover precedes one of wheat, this plant, by acting mechanically, so as to bind the surface, and perhaps also by some unknown chemical operation during its decay, produces so favourable a state of the soil, that a very large quantity of grain is frequently the result.

A gravelly soil is nearly allied to one of sand, and is subject to similar defects; the main difference, indeed, is, that

the former is mixed with small stones, generally soft, but sometimes also of a flinty or chalky nature. This soil requires to be deepened by the plough, and by frequent dressings of marl, earth, or clay, as well as enriched by liberal applications of manure. Under such management, the return, in ordinary years, will be liberal; but drought, as well as frequent and heavy falls of rain, is injurious; and, though the cultivation is easy and unexpensive, the return is not secure.

The last kind of soil which was noticed, is that of peat-moss. This, in its natural state, does not produce plants valuable for the uses of man, but is capable of much melioration. 'The fundamental improvement of all peat soils,' says Mr. Marshall, 'is drainage,* which alone will, in a few years, change a boggy to a grassy surface. After being drained, the surface may be covered with earthy materials; pared and burned; fallowed, dug, trenched, or rolled. The celebrated Duke of Bridgewater covered a part of Chat-moss with the refuse of coal-pits,—a mixture of earth and stones, of different qualities and sizes,—which was brought in barges out of the interior of a mountain; and this, by compressing the surface, enabled it to bear pasturing stock. Its fertility was promoted by the vegetable mould of the morass, which presently rose, and mixed with the heavier materials spread upon it.'†

This imperfect sketch of various kinds of soils, and the means necessary for rendering them fertile, may be enough to show the kind of ingenuity and industry destined for man to apply, in rendering them more productive. As they actually exist, they render the surface of the globe sufficiently prolific for the purposes of the lower animals, and of man himself, till the population has advanced to a certain point; but the powers of increase press so rapidly on the means of subsistence, that additional food is soon demanded, and then the

* Draining by means of tiles, or of broken stones, has lately been adopted to a great extent, and with much success, on all soils too much saturated with water.

† Marshall on Landed Property, p. 46.

labours of man, as an agriculturist, commence. He finds it easy, in this way, first to alter the produce of the soil, so as to augment the quantity of plants fit for his own subsistence, and that of those herds and flocks, which he has tamed, and rears for his use; and he gradually learns, also, to meliorate the land, and even the climate, so that, as the population becomes more numerous, new means of subsistence may proportionally be found for it. So powerful, indeed, is the law of propagation, that a constant struggle is maintained between the powers of man, in increasing his resources, and the growing amount of the population,—the latter always urging forward, and being ready to overpower the former, till, at last, the maximum of cultivation arrives, while the power of reproduction remains the same, or rather accumulates with the accumulating numbers of human beings; and thus a crisis takes place, the nature and consequences of which have already been slightly alluded to, and cannot at present again be entered upon. So far as we have proceeded, I trust the position I set out with has been satisfactorily illustrated,—that the condition in which the surface of the globe has actually been placed, exhibits the adaptations of a Designing and Intelligent Mind. Other proofs in abundance yet remain to be produced.

NINTH WEEK—THURSDAY.

MANAGEMENT OF SOILS.—DRAINING—IRRIGATION.

Before leaving the subject of soils, it seems desirable to advert more particularly to some of those processes, yesterday slightly hinted at, by which man, in the use of that reason which God has given him, prepares them, or renders them more suitable, for his use. It would be foreign to my purpose to write a treatise on agriculture, and I shall confine myself to one or two of the more prominent examples of these operations.

The estate of Spottiswoode, in Berwickshire, affords an interesting instance of successful drainage of mixed soil and strata. It was begun in 1815, under the direction of Mr. Stephens, an eminent draining engineer, and eighteen miles and a half of drains, some parts of which were thirteen feet deep, but the medium depth of which was from five to seven feet, had, in 1820, rendered between 500 and 600 acres of land highly valuable, which before was comparatively worthless.

The grounds to be drained consisted of a soil of various depth, under which commonly lay a stratum of clay, of two or three feet deep; then a thin bed of sandy or gravelly substance, of a foot deep or more, containing water; after that, another bed of clay, of two or more feet deep; and lastly, a bed of sand, gravel, or slatey rock, containing the larger quantity of water. Upon reaching the lower of these porous strata, the water disappeared in the upper one; and hence, generally, the expediency of not stopping at the first, but of working down till the main stratum was reached. Several instances occurred, where the strata lay too deep to be reached by a drain; in which cases it was deemed necessary to sink wells or pits, at certain distances, along the line of the drain, from ten to fifteen feet deep, or more, to reach the open strata, so that the water, rising through the wells to the bottom of the drains, might be conveyed away without reaching the surface. It was never thought sufficient to have reached the first seam containing water, unless it were at the depth of four feet or more, and evidently appeared to be that containing the main body of water, which occasioned the wetness of the surface.

The first operation in the process of draining, was to ascertain the depth and the nature of the strata in which the water was contained, and the overflowing of which, where no other existed, produced, as was before remarked, either springs or bursts of water, or a general oozing. 'Along the line of these springs, or in the upper part of the wet ground, pits were sunk in various places. The place of each being marked out, a man was sent to dig each pit, breaking the ground

nearly in the direction of the intended drain, six feet long and three feet wide, which is sufficient space to allow a man, or sometimes two, to work freely. The earth was then thrown to the lowest side, and well off from the pit, to prevent the sides from breaking in; these pits were made to the depth of five or six feet, or to a greater depth if necessary, according to the nature of the ground, or until the bed of sand, gravel, or rock, which contained the water, was reached.'* Having, by this operation, ascertained the direction and depth of the strata, the drains were cut, filled up with stones, and covered in; and the operation having completely succeeded in producing the desired effect, the ordinary modes of cultivation were resorted to.

The above is an example of reclaiming lands too much saturated with moisture; but plants cannot live without water, any more than they can prosper where it is superabundant. Hence the practice of *irrigation*, which mode of improving the soil I shall next consider. There are two different modes, which have been successfully employed, the one being the application of water to the surface, the other, the conveyance of it by subterraneous drains. In both practices, the object is to imitate nature, in producing motion, and in supplying the water under a clouded sky, or in the mornings and evenings, when the rays of the sun are either withdrawn, or have ceased to be intense; and the necessity of attending to this, which has been demonstrated by experience, affords a new and instructive proof of the adaptation of vegetation to the ordinary physical phenomena of clouds accompanying the fall of moisture from the atmosphere. The importance, indeed, of imitating nature, occurs to the agriculturist at every step, and constantly reminds him of such adaptations. In the present process, for example, another instance of this occurs, in the practical advantage of attending, in such a climate as ours, frequently to withdraw the water, and only apply it at intervals, thus imitating the alternate sunshine and showers of temperate regions.

* Transactions of the Highland Society, vol. vii. p. 222.

In surface irrigation, the water is conveyed in a system of open channels. This mode of watering has existed from time immemorial. Moses speaks of the children of Israel, when in Egypt, sowing their seed, and watering it with their foot; that is, as Calmet explains it, raising the water from the Nile by means of a machine worked by the foot, from which it was conducted in such channels as are used in the present day. This practice, which is still common in Egypt, was doubtless suggested by the peculiar climate and circumstances of the Delta of that country, where rains very seldom fall, the want of which is supplied by the periodical overflowings of the Nile. There are many places even now, in that region, and there must have been many more in those early times, when alluvial formation was not so deep or so extensive as it has become in the revolution of ages, which the waters of the Nile did not reach in its inundations. These situations would, of course, prove barren from want of moisture. The thought would naturally occur, that an artificial application of water to these places, would be advantageous, and the use of a wheel for raising the water from the river, seems to have very early suggested itself to some ingenious projector, as the means of accomplishing this object. The invention was too important not to be eagerly adopted by an industrious nation, whose population was rapidly increasing, and was confined to certain limits by the nature of the country, enclosed, on its different boundaries, by seas, barren mountains, and still more barren sands. Hence, perhaps, the origin of surface irrigation,—a practice very generally pursued in various parts of the world. The wheel used by the Egyptians, in those early ages, was probably a more simple machine than the *Noria*, also an Oriental invention of very remote antiquity, but of great power, which was introduced into Spain by the Moors, and is still extensively used in the Southern and Eastern provinces of that kingdom. This ingenious piece of mechanism consists of a series of earthen jars, attached to an endless rope. These pass over a vertical drum, put into motion by a trundle and horizontal cog-wheel, which last

is usually turned by a single bullock, or more, when the size of the machinery requires it.

Subterraneous irrigation is effected, either by a system of drains or covered gutters, in the subsoil, or where the under stratum is gravelly, and rests on a retentive bed, by merely damming up surrounding trenches, if the ground be flat, or leading a stream along the highest elevation, if it be sloping. This practice is used in Lombardy, on the alluvial lands near the embouchures of the Po. In Lincolnshire, the same mode is practised, by shutting the flood-gates at the mouths of the great drains, in the dry seasons, and thus damming up the water through the ramifications of the drainage from the sea to their source. A similar plan, on a smaller scale, has, in some instances, been practised in Scotland, where deep mosses had been drained and cultivated, and where, in summer, vegetation failed from deficiency of moisture.

NINTH WEEK—FRIDAY.

BLAIR-DRUMMOND MOSS.

I SHALL, in this paper, detail another mode of successful cultivation, which has been adopted on a large scale, in one locality, and the principle of which, though not of general application, may doubtless be employed in other situations. I allude to the method of reclaiming a fertile soil, by the removal of a barren surface, which has been practised in the parish of Kincardine, in the neighbourhood of Stirling.

The Moss of Kincardine extended to upwards of 2000 acres, 1500 of which belonged to the estate of Blair-Drummond. It lay upon a clayey bed, which is a continuation of the rich alluvial soils that form the flat vales, called *carses*, of Stirling and Falkirk. The plain in question had, at some early period, been covered with trees, which had been felled, probably by the Romans; and this, by a natural process, already alluded to, ended in producing the moss. This moss consists

of three different strata: the first, or lowest, black and heavy, appears to have been formed of bent grass and fallen trees; the second is composed principally of *Sphagnum palustre*, and is brown, and of an elastic texture. The third is about a foot thick, and consists of heath, and a little bent grass. In general, these three strata are about the depth of seven feet. Lord Kames obtained possession of this moss in 1766; and, soon after, conceived the idea of floating off the strata into the Frith of Forth, and thus exposing the alluvial soil for cultivation. After various interesting experiments, which I cannot stop to detail, he adopted the following plan:—

His first object was to procure a sufficient quantity of water to create a stream, of force enough to carry off the moss in its current. This was done by the erection of a wheel, somewhat resembling the Persian wheel, or Noria, already described, but of great dimensions, and on an improved principle. It was twenty-eight feet in breadth, and was driven by water, with float-boards, in the same way as an ordinary mill-wheel. At the extremities of the radii, or arms of the wheel, immediately within the float-boards, was fixed a double row of buckets, opening upwards when at the bottom of the circumference, and downwards when at the top. These received two streams of water, which were poured into them when they were below, and which they discharged when they ascended and were inverted by the revolution of the wheel, into a trough or cistern, so placed as to receive it above. By this means, a level was gained of seventeen feet, which was sufficient to make the water run to the surface of the moss. The water was conveyed from the cistern of the wheel, to the moss, for 354 yards below ground, in wooden pipes, hooked with iron, eighteen inches in diameter within; and afterwards rose from the pipes into an open aqueduct, about 1400 yards in length, and elevated from eight to ten feet above the level of the adjacent grounds.

Having thus obtained the necessary power, the work of removal was begun; and, for accomplishing this, the first step was to make, in the clay, alongside of the moss, a drain to

convey the water, for which operation the *carse* clay below the moss was peculiarly favourable, being perfectly free from stones, and all other extraneous substances; and, at the same time, when moist, being slippery as soap; so that, not only was it easily dug, but its lubricity greatly facilitated the progress of the water, when loaded with moss. The dimensions proper for the drain were found to be, two feet for the breadth, and the same for the depth. If smaller, it could not conveniently receive the spadefuls of moss; if larger, the water would have escaped, leaving the moss behind. The drain had an inclination of one foot in a hundred yards. The more regularly this inclination was observed throughout, the less was the moss liable to obstructions in its progress to the river. The drain being formed, the workman marked off, to a convenient extent, alongside of it, a section of moss, ten feet broad, the greatest distance from which he could heave his spadeful into the drain. This operation he repeated, till the entire moss was removed, almost down to the clay. He then dug a new drain, at the foot of the moss-bank, turned the water into it, and proceeded, as before, leaving the moss to pursue its course into the river Forth, upon the fortunate situation of which, happily forming, for several miles, the southern boundary of the estate, without the interposition of any other property, depended, in some measure, the very existence of the whole operations.

When the moss was nearly removed, the clay was found to be encumbered with roots of different sorts of trees, often very large, remaining in it as they grew. Their trunks also were frequently found lying beside them. All these the tenants removed, often with great labour. In the course of their operations they purposely left a few inches of moss upon the clay. This, in spring, when the season was favourable, they reduced to ashes, which, in a great measure, insured the first crop. The ground thus cleared, was turned over, where the dryness admitted, with the plough; and, when too soft for that operation, was dug with the spade. A month's exposure to the sun, wind, and frost, reduced the clay to such a state as

fitted it for the seed in March or April. A crop of oats was the first produce, which seldom failed of being plentiful, yielding from eight to ten bolls after one.*

The ingenious and successful operation above described, is only applicable to very peculiar localities, where various circumstances concur, not usually combined. The fine tenacious alluvial soil beneath, and the immediate neighbourhood of a river, very happily united to afford facilities to this singular undertaking; but, in any light in which it can be viewed, it furnishes a striking instance of what the skill of man can effect, in increasing the natural resources of the soil; and it should serve to quicken ingenuity, and excite enterprise, in an object of so much importance. There is, doubtless, much waste land in Europe, and even within the bounds of the British Islands, which, under a spirited system of improvement, might be made to yield, if not an equal, at least an adequate return. Peat-bogs and swamps might be drained; downs might be arrested in their progress of devastation, and even sometimes removed; commons might be divided; forest-lands might be cleared; rivers might be embanked; and, in many instances, large tracts of valuable soil might be reclaimed from the sea; while water might be procured from the bowels of the earth, by sinking Artesian wells, or streams might be profitably turned from their course, to cheer and fertilize districts rendered barren from a defect of moisture. These are some of the expedients which Providence has placed within the power of man, to enable him to add to the means of human subsistence, while they call forth and usefully exercise his faculties.

It is true, that, as a mode of counteracting the inconveniences arising from the law of propagation, such operations can only prove a partial and temporary relief, even when conducted on the largest scale; for such is the elasticity of this law,

* Farmer's Magazine, vol. xviii. Mr. Home Drummond, the present proprietor, completed, in the summer of 1836, the whole of the operations projected by his ingenious father; but other proprietors in the neighbourhood have adopted, and are carrying on, the same mode of improvement.

that the population could not fail, in a few years, to be again pressing, with the same force as ever, against the supply of food; but, in the meantime, the numbers of the human race would be permanently augmented; many happy and industrious families would be reared, within the boson of the country, which would otherwise not exist at all, or would be carried away, by emigration, to increase the wealth and strength of foreign lands; and the general salubrity of the climate would be increased, as well as the effective resources of the state.

NINTH WEEK—SATURDAY.

PRODUCTS OF THE SOIL.—DISSEMINATION OF PLANTS.

From the preparation of soils we naturally pass to the consideration of the various productions which are the objects of culture. But before entering on this subject, a few introductory remarks may be desirable on the creation and natural diffusion of plants in general.*

The sacred record does not inform us whether the whole of the numerous races of the vegetable kingdom appeared simultaneously in every part of the globe where the soil and climate were suitable for their growth, or emerged from particular localities fitted for the production of all the species. That such localities exist, we have good reason to believe. The Himmalayeh Mountains, for example, afford specimens of almost every climate. Situated within the tropics, and yet stretching their lofty summits till they penetrate the region of perpetual snow, they seem to contain within themselves a microcosm, in which all temperatures and all terrestrial zones are represented, and where the productions of every parallel on the face of the globe may find adequate and congenial

* For much of the substance of this paper, I am indebted to Mr. Sharon Turner's 'Sacred History of the World' (Letter vii.), though I do not adopt his theory.

nourishment. To such a situation, it is possible, that the Creative energy may have been confined; and, on this supposition, it is no very difficult matter to conceive how the various plants, and even animals, may have been gradually diffused over the terrestrial surface. At all events, granting that the various species of organized existences were produced by an universal Creative energy, and that thus the earth became peopled with animals, and clothed with vegetation at once, a new diffusion must have become necessary after the ancient surface of the globe had been overwhelmed with the flood. It is true, as I formerly noticed, that the waters of the universal deluge would diffuse the seeds of plants very generally over every region; and, where circumstances were favourable, those which happened so be deposited on or near the surface, would quickly vegetate. But there is reason to believe that another process has likewise been extensively employed.

If we consult our historical and geographical communications on this subject, we find that the vegetation of many countries which have been examined, and of all newly formed islands, has been, and still continues to be, progressive; and we may trace it ourselves on many places near our domestic residence. We have already noticed the first processes in the formation of soil, which are still in progress. We see the lichen class arise as their minute seeds descend, and decay and reappear from new germinal matter, till they have formed enough of vegetable substance for the sporules of the mosses, which, at their seasons of fructification, float extensively in the atmosphere, to fix on and to grow from. These mosses, also, vegetate and decay; and on their decayed remains, a new vegetation of the same sort springs up, in like manner to die, and become a thicker mould for the germination of the passing seeds of other plants. Every year thus produces a new bed of vegetable matter, which is frequented by the seeds of new plants, and, in time, of trees, as various causes bring them to the spot. Thus, in the course of a few years, every new coral island that is made by its petty architects,

and every volcanic one that rises in the sea, become covered with plants and trees.

It has been observed of the rocky places, where only the lower and smaller classes of vegetable nature can subsist, that the seminal particles do not spring up from some, but yet will evolve from others. Each, as it floats along the ever-moving breeze, selects, as it were, its own proper bed of nutrition, and there unfolds its efflorescence, and produces its successor. Aqueous plants would in like manner arise, as their seeds were wafted to watery places. And in this way vegetation has assuredly, in many instances, spread from the district where it was flourishing, to those which it had not before reached. The processes I have mentioned would soon clothe the earth with an abundant vegetation, and would everywhere precede the dispersion of the lower animals or man, providing for them the means of subsistence, to whatever region they should happen to wander. That one of the means by which vegetation has been spread over the earth, is the gradual dispersion which I have described, is certain from the fact, which history and observation unite in establishing, that the largest portion of the herbs and trees, which any nation now possesses, has been thus successfully introduced. We can trace the chronology, and date at no very distant period the origin, of no small part of our own insular vegetation; as we can also of several of our fishes, birds, and quadrupeds. It is natural to infer from what we know to have thus taken place in the latter ages of the world, that similar processes operated in its primordial times.

It must further be observed, that the vegetable soil on the surface of the earth, is, by the very process of alternate growth and decay, always tending to greater depth and fertility, at least in the more favoured situations. Hence it follows, that localities are constantly changing their capacity for sustaining particular kinds of vegetables, and this consideration alone renders it probable that the vegetation of every country has progressively advanced in the multiplicity of its species, according as the mould became fitted to receive and nurture the more important plants.

Whether the primeval creation of vegetation was its instantaneous and universal diffusion over all the globe, or the emergence of it only on so much of the surface as would allow every species to appear, with a subsequent dissemination of it to every other part, by gradual succession, still we may be sure, that the same results would occur on either system. If the first formation were immediate and general, it would be but an instantaneous production of the same effects as the progressive diffusion would occasion. No spot could or would have the whole body of all plants upon it, but every place would have its own suitable vegetation, whether immediate or gradual. The marsh, and the sea-shore, and the bed of the ocean, would protrude those of the watery species; the rock would retain the lichen, the barren soils would receive the heath or the thistle; the valley would cherish those that suit the low ground; and the mountain possess such as flourish best on elevated regions, while trees would arise in the localities fittest for their production. Each district would have at first what would grow best upon it, and all would begin the disseminating process, as soon as their reproductive systems came into action. Diffusion is the law, and must have been in constant operation, from the first period of their being. Those parts which had only the minor species of plants, would have those of the higher classes, as soon as sufficient seasons and their decayed foliage had prepared a soil adapted to the germination of their arriving seeds. Whatever was brought or wafted, would vegetate only where it found a soil fitted for its nature; and thus, within a century or two after its creation, the surface of the earth would be nearly in the same state, as to its herbage and forests, whether they originated from a particular locality, or from a universal formation.

TENTH WEEK—SUNDAY.

THE SOWER.

THE most important operation in the fields at this season, is unquestionably the sowing of the seed. On it the support of man and many of the inferior animals, chiefly depends. But, independently of the importance of his labours, the sower, as he stalks along the freshly ploughed field, is one of the most pleasing objects that spring presents to our observation. The sight of him heightens our enjoyment of the passing season, and in an instant transports us to the yellow treasures of harvest. There are associated with him many pleasant feelings, many poetic images; and if ever the oft-imagined picture of a peaceful age strikes us with all the force of reality, it is when we see him scattering the seed from his well-filled sheet, and surrounded with the various lively adjuncts of rural labour.

But the sower may be made the subject of much profitable reflection, well suited to the employments of this holy day. His labours are, of all others, pregnant with instruction. Why does he toilfully traverse the rough furrows, and cast from him the valuable grain to mingle with the earth? Why does he, with much pains and industry, first prepare the soil, and even when the seed is sown, tend it with unwearied diligence? It is because he confidently expects a bounteous return for all his anxiety and labour. He thus practically shows an unwavering belief in a coming harvest. Now, what lies at the bottom of this belief, which is as strong as assurance itself, but his experience of the undeviating uniformity of the great laws by which the world is governed? And what are these laws but the operations of the Supreme Ruler of heaven and earth? The sower, then, even though his understanding be unenlightened, and his heart untouched with pious emotion, may be said to depend upon the continually exerted goodness of that God who animates and directs

all nature, and who pronounced the primeval promise,—'While the earth remaineth, seed-time and harvest, and cold and heat, and summer and winter, and day and night, shall not cease.' He knows that the seed he commits to the eartth immediately corrupts; but that the miracle of the green blade springing up from the decayed husk, and containing the germs of the future grain, will not be performed, never once enters his mind. With the implicit belief of a child, he awaits the unfolding and ripening of the precious ear. And what ground has he for his trust, we again ask, but the goodness and faithfulness of God? Thus, the sower, in regard to temporal things.

Now, the same Almighty Being who has pledged his word for the continuance of seed-time and harvest, and has promised 'seed to the sower and bread to the eater,' has also promised to feed his people with the bread of life, and to make them 'reap if they faint not.' But while we admit his gracious promises, we continually exhibit a practical distrust in them all. We share the hope of the sower, and with him expect to be annually supplied with food; but our expectation of a constant supply of spiritual good things is neither so cherished nor so lively; as if God were indeed more solicitous to support our mortal bodies, than to feed with heavenly food the undying spirits within us. We are ever apt to be so grossly inconsistent, as firmly to rely upon the constancy of Nature, and yet have but a feeble faith in the written promises of Nature's God. We believe that, in a few short months, harvest will assuredly arrive; but we realize not, with the proper vividness and power, the glorious harvest to be reaped by the redeemed, both in 'the life that now is, and in that which is to come.' Yet our plain duty is, to trust God in all things,—in his word as well as in his works; to expect the spiritual sustenance and joy he has promised to his duteous children, with the same faith that we display in looking forward to the budding beauty of spring, or the teeming abundance of autumn.

When we see the sower scattering his seed, we are naturally

reminded of the apostle's beautiful illustration of the resurrection of the body. The grain deposited in the earth soon corrupts and is changed; but yet there upspring from it the elements of other seed; it dies, as far as regards its qualities as corn, but is immediately quickened for the production of grain like itself. So our mortal bodies are laid in the grave, and moulder away into their native earth; but the day is coming, when, from their silent resting-places, they shall rise to the re-enjoyment of life and breath. The tomb has also its wondrous and instantaneous spring: and as the grain that rises from the ground is not that which was sown, though essentially produced by it, so the risen bodies of the just are not the corruptible bodies that now descend to the earth, but glorified and spiritual frames, meet for heaven and unfading joy; —incorruptible and immortal, though sprung from decayed and earthly elements. Such is the glorious doctrine of the resurrection. O! can we fail to look forward to it with the most vivid expectation? Will not the same God, who, in the upholding of natural laws, causes, year by year, the grain to spring up from seeming dissolution, much more raise up at the appointed day, those fleshly tabernacles that now sink into the corruption of the grave? Surely, if he disappoints us not in the operations of his daily providence, and makes the constancy of Nature fulfil our certain hope, he will not deceive us in greater things, but will faithfully perform that most animating of all his promises, a resurrection to immortal glory.

There is also another impressive scriptural analogy connected with the sower. We are familiar, from our childhood, with that beautiful parable, in which the word of truth is represented by the seed which he commits to the earth. How apt and striking the emblem is, all must at once perceive. Many causes prevent or check the growth of the sown grain. It may be picked up by the fowls of heaven; the green blade may be choked by noxious weeds, or it may be withered by a scorching sun; and thus frequently more seed, in various ways, perishes, and produces no return, than swells the treasures of harvest. So it is with the preaching of the Gospel.

The temptations of our great spiritual adversary, the love of riches, the multiplied seductions of sense, persecution, and the various afflictions inseparable from a bold profession of the truth—all conspire to render ineffectual the doctrine of a crucified Redeemer. The gradual and imperceptible growth of the seed, that takes root, and brings forth fruit to maturity, is also beautifully illustrative of that growth in grace which distinguishes the true believer,—that silent extension of the kingdom of God which takes place in his heart.

We have not nearly exhausted the fertile subject of the sower's interesting labours. As he scatters the seed, he teaches many impressive lessons. Yet the operation he performs is only one of many that are constantly affording us instruction. Indeed, all the changes and objects of nature, all the splendid phenomena of the seasons, and all the labours of the husbandman, are fraught with the sublimest moral lessons; many of them are also eternally associated with the instructions and arguments of the Saviour and his inspired followers. J. D.

TENTH WEEK—MONDAY.

DISSEMINATION OF PLANTS.—THE COCOA-NUT TREE.

An instance of the power of the dissemination of vegetable substance, and, at the same time, of their adaptation to the use of man, is to be found in the history and properties of the cocoa-nut tree, which is so remarkable, and so strikingly illustrates the observations of last Saturday's paper, that it seems worthy of separate consideration.

The wonderful operations of the coral animalcule shall come under our notice afterwards; at present it is enough to observe, that by the continued labours of this tiny creature, through a succession of ages and generations, islands are

gradually formed in various parts of the vast South Seas, rising abruptly from the bed of the ocean, sometimes when it lies at the depth of several hundred fathoms. The matter which the coral insects secrete for their habitations, and which thus eventually forms, as it were, a new creation, is carbonate of lime, a substance which, on being elevated above the surface of the ocean, is slowly decomposed by the atmosphere, and combining with materials cast up by the waves, forms a soil fit for the support of some kinds of vegetable life. Among these, the cocoa-nut tree seems endowed by the Author of Nature with peculiar properties, for the express purpose of rendering these new made islands habitable. From an interesting account of this tree in the Wernerian Memoirs,* we learn, that it will grow on the sand of the sea-shore, where scarcely any thing else will vegetate; and Mr. Johnston informs us, that it has a very slight root, so that it is difficult to understand how it adheres to the earth, which it does, however, with sufficient firmness.† These properties admirably fit it for forming the first vegetable produce of the higher order, destined to clothe the new formed islands of the Pacific; and, accordingly, we find it every where readily springing up, as soon as a scanty soil is prepared to receive it. The manner of this process is thus described by Captain Flinders, after stating that the animalcules cease to work above low water mark:—'The coral sand and other broken remnants thrown up by the sea, adhere to the rock, and form a solid mass with it, as high as the common tides reach. That elevation surpassed, the future remnants, being rarely covered, lose their adhesive property; and, remaining in a loose state, form what is usually called a key upon the tops of the reef. The new bank is not long of being visited by sea birds; salt plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandorus, is thrown on shore; land birds visit it, and deposit the seeds of shrubs and trees; every high tide, and still more, every gale, adds something to

* Vol. v. p. 107.

† De Arboribus, p. 145.

the bank; the form of an island is gradually assumed; and, last of all, comes man, to take possession.'*

All this indicates an adaptation of the plants which grow in these tropical regions to this very peculiar formation. These are naturally formed to vegetate on a loose and shallow soil; and, of this class, all travellers have particularized the cocoa-nut, as at once the most remarkable and the most abundant. Forster says, that the recently formed islands of tropical seas, are commonly 'narrow low edges of coral rock, including, in the middle, a kind of lagoon, and having here and there little sandy spots, somewhat elevated above the level of high water, on which cocoa-nuts thrive.'† Captain Cook confirms this description. In mentioning one of these islands, or, what he calls a coral shoal, of about twenty leagues in circuit, he observes, 'A very small part of it was land, which consisted of little islets, ranged along the north side, and connected by sand-banks and breakers. These islets were clothed with wood, among which the cocoa-nut trees were only distinguishable.'

Now, let us consider the properties of this wonderful production. Johnston, speaking of the cocoa-nut tree in India, affirms, that there is no part of it which is not applied to some useful purpose. Not only the cabins of the poorer natives, but large houses, are constructed entirely with materials afforded by this tree; the trunk, when split, supplying rafters, &c., and the leaves, when plated, making roofs and walls, which are impervious to wind and rain. This statement of Johnston is confirmed by Seely, in his account of Ellora, who says, that, when he was stationed at Goa, in 1809, he lived, as many others did, in a cocoa-nut leaf-house; and that, although the period was in the very height of the monsoon, and the house was on the sea-coast, it was comfortable and warm. He believes that not a nail was used in the whole building; the rafters, supporters, &c., were fastened on with string made of the fibrous envelope of the cocoa-nut shell; the

* Flinders' Voyage, vol. ii. pp. 115, 116.

† Forster's Voyage, pp. 14, 15.

wood was the tree itself; the roof, walls, doors, and windows, were formed of the leaf. From the same authority, we learn, that the fibres, enveloping the shell of the nut, have frequently been woven into a cable, by which ships of seventy-four guns have safely rode out heavy gales of wind, when European cables have parted.*

It is said by other authors, that the leaves of this tree serve for food to elephants; and that the ashes of the wood contain so great a proportion of potash, that the native fishermen of Ceylon use them instead of soap. But those properties of the cocoa-nut tree, which, in the view we are now considering, are the most admirable, are the qualities of its fruit, as an abundant and useful article of food. We are informed, that the tree yields produce twice or thrice in the year; that it is fruitful from its eighth to its sixty-fourth year; that it sometimes bears a hundred nuts annually; and that it is to be found in such quantities, that, in the year 1813, the numbers in Ceylon, along a line of coast of about 184 miles, were not fewer than ten millions.

The half-ripe nut contains sometimes three or four pints of a clear aqueous fluid, fragrant and pleasant to the taste; and the nut itself, from its highly nutritious qualities, is used as an aliment in all intertropical countries.† If the extremity of the sheath, from whence the flowers of the cocoa arise, be cut off while young, a white sweet liquor distils from it, as well as from other palms, which is used extensively as a beverage in India, under the name of *palm wine.* This liquor, if concentrated by boiling, deposits a sugar;—if exposed to the air, it acquires vinous properties at the end of twelve hours, and, at the end of twenty-four hours, becomes vinegar. An oil may be obtained from the nut, which is not inferior to sweet almond-oil, and which is used almost exclusively in India. The shell is formed into cups, and various other small articles.‡

* Ellora, p. 283.

† Wern. Mem. vol. v. pp. 110.127.

‡ Nouv. Dict. de Hist. Nat. tom. vii. p. 297.

The remarkable properties I have detailed, cannot be viewed without recognizing the hand of a beneficent and provident Creator, who has not only bestowed this abundant and varied blessing on the originally habitable earth, but, foreseeing the formation of new islands, from the depths of the wide ocean, the produce, in remote ages, of minute animalcules, gifted this vegetable production with every quality, which might render it useful to the human beings who should be cast on these solitary coasts; and, fitting it to spring from a half-formed soil, provided it, in its buoyant and thickly-coated shell, with a boat, in which it might be wafted by the winds, the waves, and the tides, to such distant localities. The ways of the Almighty are always wonderful; but there is something in these adaptations of different departments of Nature, to preserve the lives, extend the numbers, and promote the comforts of human beings, which fills the mind with amazement and devout adoration.

TENTH WEEK—TUESDAY.

MITIGATION OF SEASONS OCCASIONED BY CULTIVATION.

It is exceedingly edifying to examine, in all its phases, the nature of that discipline, by which Providence trains the human race, and the character and extent of those means, by which their moral and physical powers are stimulated, and the exercise of these powers is rewarded. I have already taken various opportunities of calling the reader's attention to this subject, but it recurs continually, and the more it is examined, the more interesting it becomes. It has been truly said, that 'the hand of the diligent maketh rich.' But this is not the only, nor indeed the chief, reward of a well-directed and properly-regulated industry; it also promotes the health, and improves the understanding, and thus stamps with the seal of

truth the homely adage of poor Richard, which is in every body's mouth—

> 'Early to bed, and early to rise,
> Makes a man healthy, wealthy, and wise.'

But even this is very far from being the whole of the blessing which Providence has annexed to habits of activity and attention to the various callings of life. The advantages acquired by individuals are extended to society, and thus the necessaries of life become more abundant, and its comforts and conveniences are, both directly and indirectly, promoted in a thousand different ways. Nature itself seems to become more propitious under the ingenuity and laborious exertions of man, and to relax in her more rigid features, as society advances in civilization.

I have, at present, chiefly in view some remarkable facts, in reference to climate, which seem to prove that it is affected, in an extraordinary degree, and in a very salutary manner, by the cultivation of the soil. Evaporation is a well-known cause of cold, the conversion of water into vapour being necessarily attended by the absorption of much heat; and whatever promotes the one, must, at the same time, have a tendency to increase the other. Now, a great part of the Continent of Europe was anciently overrun with immense forests, which produced this effect, by their leaves and branches exposing a large surface to the action of the air; while, at the same time, they diminished the power of reflection, by intercepting the direct rays of the sun. Another and very extensive cause of excessive evaporation in uncultivated grounds, is the existence of swamps, and of large tracts of land overloaded with moisture. Cultivation has the effect of diminishing these sources of cold, by the clearing away of the woods and the draining of the soil, both of which operations have actually been performed in Europe to a great extent; and the change, which has thus been produced, is greater than, independent of experience, could easily have been anticipated. Hume, in his 'Essay on the Populousness of An-

cient Nations,' has investigated this subject with his usual acuteness, and has brought together some curious facts, which show that the European climate is now much milder than in early times. Italy, for example, has at present so warm a climate, that winter frosts are almost unknown. It was not so formerly. Horace speaks familiarly of the streets and neighbourhood of Rome being frequently covered with snow and ice. In the year of the city 480, the winter was so severe, that the Tiber was frozen firmly over; the trees were destroyed by the intensity of the cold; and the ground was covered with snow for forty days. This was, indeed, an unusual occurrence; but Juvenal, in describing a superstitious woman, represents her as breaking the ice of the Tiber, that she might perform her ablutions;* and he speaks of that river freezing over as a common event,—a circumstance which never happens in the present day. In other parts of Europe, a similar difference is indicated. Gaul was anciently represented as a most inhospitable climate. Petronius proverbially speaks of something being *colder than a Gallic winter.* Aristotle says, that the climate of Gaul was so cold, that an ass could not live in it. Diodorus Siculus describes it in similar terms. He speaks of its extremely severe northern climate, where, in cloudy weather, snow falls instead of rain, and, in clear weather, the rivers are frozen so hard that large armies may pass, with all their baggage and loaded waggons. Strabo states, that the northern parts of Spain are thinly inhabited, on account of the great cold. Varro speaks of the inland countries of Europe, as invested with almost perpetual winter; and Ovid mentions the Euxine as, in his day, frozen over every year.

On comparing these accounts with the state of the European climate in modern times, we cannot fail to observe a most striking and general amelioration; and we need not hesitate in attributing the change to the effects of agricultural improvement. The climate of North America is, from the

* Hybernum, fracta glacie, descendet in amnem
Ter matutino Tyberi mergetur.—Sat. vi. 523.

same cause, becoming gradually less severe, and assimilating itself to that of Europe. Wherever the ground is extensively cleared of wood and cultivated, the mildness and salubrity of the weather is materially increased.

These remarks on the effects of cultivation, as producing a salutary influence on the climate, during winter, lead us to notice a not less important change, effected by the same cause, in the other seasons of the year. When the earth is barren, the alternations of heat and cold, and of rain and drought, are very violent. A vigorous but not prurient vegetation has a wonderful tendency to correct these injurious excesses, and, by diffusing the temperature and moisture more equally, to render such agents at once the means of additional fertility to the soil, and health to the human constitution.

In adverting to this subject, it is impossible not to remark, as a peculiar proof of beneficent design in the Author of Nature, that of all the vegetable productions, none tend so much to promote this beneficial result, as those which are cultivated for the food of man, and the domestic animals. 'By the shade which they afford to the ground in the hot season,' says an intelligent writer, to whom I am indebted for some of the above observations, 'they check that evaporation, and prevent that excessive hardening of the surface, which, in an exposed wild, render the soil impervious and inert; while, on the other hand, the humidity, which they imbibe during the rainy season, is again given out, by continual and gradual evaporation, and they minister to the refreshment and productiveness of all around them.'*

To prove the unmitigated action of the elements, in regions destitute of cultivation, the same author refers to the present state of some parts of India, of Southern Africa, and of Australia, where, at one time, the earth is parched, and the beds of rivers become dry channels, or unconnected pools; while, at another, they suddenly pour onward to the sea, in a wide-spreading inundation, or roll their rapid floods in narrow but deepened channels; and, to show how powerfully these evils

* Library of Entertaining Knowledge, vol. xv. Introduction.

are modified by human industry, he mentions the remarkable change which, even within the memory of man, has taken place in those parts of Scotland where agriculture has, during the last hundred years, been rapidly improved. 'It is within the experience of persons still living,' says he, 'to have noticed that the snow, which, in that country, began to fall in November, was not wholly gone till the month of April; while, in the middle of summer, the heat was so excessive, that agricultural labourers were obliged to suspend their toil during four or five hours in the middle of the day. At that time, the autumnal rains frequently descended with so much violence, that the crops, which had been retarded by the coldness of the spring, were prevented from ripening on the high grounds, were lodged and rotted on lands that were lower, and swept away by the swelling of the streams over the holms and meadows.'

Though the above account may perhaps be justly said to be somewhat overcharged, yet the mitigation of the Scottish climate, in all these particulars, is well known, and is wholly to be attributed to the progress of agricultural improvement. This has had a very salutary effect on the health of the inhabitants, as well as their means of subsistence, and may be fairly stated as a striking instance of the nature of those blessings which Providence has so bountifully, and in such a variety of ways, annexed to human industry.

TENTH WEEK—WEDNESDAY.

THE LABOURS OF THE HUSBANDMAN WISELY DISTRIBUTED OVER THE YEAR.

THE wonderful adaptation of organized existences, both animate and inanimate, to the seasons of the year and the cosmical arrangements of the globe, on which it has pleased Providence to place them, has already been noticed.* But

* See '*Winter*' Volume, Fourth Edition, p. 70. Paper 'Adaptation of Organized Existences to Seasons and Climates.'

there is one remark which has not yet been made, and which tends not only to illustrate our general argument, but to show that the more minutely we observe the features stamped upon the system of which these existences form a part, the more reason we have to admire the nice and well-considered adjustments which it invariably manifests. The particular to which I now allude, refers chiefly to the variety that exists in the proper seasons of germination, and in the periods necessary to the ripening process, in such of the vegetable productions as are useful to man, and are raised by his labour. By far the larger proportion of them require only one season to bring them to maturity, being sown and reaped in the course of a single year; but, among them all, there are not perhaps any two which occupy precisely the same number of weeks, or which need to be sown and reaped precisely at the same seasons. Late in autumn, and during the months of spring, they are all committed to the earth, and begin to vegetate, continuing to increase through the heats of summer, till they are at length gathered in for the sustenance or the comfort of man and his dependants.

Now, let it be remembered, that, in a densely-peopled territory like our own, there is no such thing as a spontaneous production, to which the wants of the human race and the domestic animals can be intrusted. Were man to cease from labour, the earth would soon refuse to yield her increase; and there is a proportion thus established, in every country, between the amount of industry, judiciously applied, and the number of the animal creation, which the soil is capable of nourishing. The favourable rate of this proportion to animal life which at present exists, however, as will immediately be seen, is very dependant on the variety to which we have alluded in the periods required to bring the useful vegetables to maturity.

We could easily imagine an arrangement to be established, by which the progress of the annual fruits of the soil from germination to maturity, should not only be precisely adapted to the solar year, as we have seen them to be, but should each

have to run a precisely similar course; the seeds of them all requiring to be sown at the same period of the year, and swelling and bursting together; the young blades and stalks, and leaves and roots, in them all, advancing with equal rapidity through the months of summer, and all of them arriving at a state of ripeness at precisely the same period. Such an order of things, it is clear, would require the husbandman so to arrange the operations of his farm, that the soil might be ready at the same particular time in spring, for the reception of every variety of grain and other seed, the produce of which he might desire to reap in autumn. The deviation of a very short period, in committing any of them to the soil, must, it is evident, on this supposition, necessarily derange the progress of the vegetable fluids, and endanger the safety of the crop; while the risk arising from a want of punctuality in spring, must be very greatly increased by neglecting to seize the proper period for gathering in at last the ripened produce. Now, what must have been the effect of all this upon the operations of husbandry? Nothing can be more evident. The labours of the spring and of the harvest being, in each case, crowded into a few weeks, must have been hurried forward with tenfold precipitancy. A vast accession of hands must have been required to accomplish the work within the prescribed time; and the extraordinary exertion once over, several months would necessarily elapse without any serious labour being requisite, or any adequate occupation presenting itself for the general population. Some idea of the difficulties which must have attended such an order of things, may be formed by the agriculturist, who has experienced the inconveniences arising from the simultaneous ripening, which sometimes occurs, even of but one principal crop. He has found the necessity of summoning to his aid the whole available population of hamlet and cottage, and has discovered, to his disappointment, that his neighbours around him, having felt the same need, have already forestalled him in the market, and drained the ordinary physical resources of the whole district; so that it is only by offering an exorbitant inducement that the old, or the fee-

ble, or the very young, or the independent, can be brought to do the work, which would have been both better and more cheaply performed by other hands, had the season been less precipitate, and the ripening process more gradual. The subsidiary force that can be called out on such extraordinary occasions must always be limited; and it has sometimes occurred, that the farmer has been obliged, with pain, to witness the destruction of his finest crops, merely because he could not command a sufficiency of labour in time to secure them, ere the period of ripeness had given place to that of over-maturity and decay.

On the supposition which has been made, therefore, were it possible to give the plan a fair trial, it is very obvious, that the first requisite would be an immense increase of population, to carry on the business of agriculture. Now, what would be the immediate consequence of this? The equilibrium that now exists between the number of mouths and the amount of edible produce, would be overturned; the land would fail to support the people necessary to its culture; these would die in large multitudes from starvation; the soil, in turn, would languish; in the second year of the experiment, its resources, thus still further curtailed, would prove inadequate to afford even the diminished quantity of sustenance which would be required; and at what point short of utter desolation, the destructive effects of the arrangement would cease, it is not easy to form any idea.

How much better and wiser, then, is the system which we behold actually at work on the face of a cultivated country like our own. When we set out with the husbandman, after the conclusion of his harvest labours, which may be aptly styled the commencement of the agricultural year, and follow him as he proceeds through the varied duties of the whole cycle, till we arrive with him at the same point in the following year, from which we had begun in the preceding, we observe that there is a perpetual alternation of employments, by which the amount of labour required upon the farm, at each period of the year, is pretty nearly equalized. One descrip-

tion of agricultural produce requires a longer union with the soil than another. Wheat, for example, should be sown in autumn. Oats ought not to be committed to the earth till March. Barley must be delayed still longer; while potatoes may be planted in May, and turnips drilled in June. This variety in the periods of seed-time, is not more remarkable than that which occurs in those of ingathering. The first principal crop reaped in this country is rye-grass, upon which the sustenance of several of the valuable animals reared and employed upon the farm mainly depends. Mowing commences in June; and no sooner has this crop been secured, than the natural hay of the meadows demands the attention of the husbandman. Hard upon this crop follows the ripening of the various descriptions of grain, differing from one another in their periods, and the early and late varieties of each contributing still further to spread the process over a considerable proportion of autumn. The joyous harvest home closes the year.

The distribution of the labours requisite for the cultivation of the soil, however, beautiful as it is, does not so perfectly equalize the exertions of the several seasons, as to afford no periods of relaxation from the regular business of the farm. The arrangement produces only an approximation to this state, and an approximation is all that is required. There are many short seasons intervening, of which the farmer knows well how to take advantage for securing fuel, cutting drains, rearing fences, forming embankments, and superintending other operations, which can be performed during any part of the year, when the duties peculiar to the several seasons cease to demand attention. Nor is there wanting to the agricultural labourer a time of innocent relaxation and mirth; for, during the frosts of winter, when the hills and valleys are bound with ice, and the plough can no longer penetrate the surface of the ground, he can lay aside for a little his daily labours, and improve his mind by reading, or exhilarate it by social intercourse, thus unbending from the rigours of his la-

borious life, and by a few days of useful or innocent amusement, lightening the toil of a whole year.

G. J. C. D.

TENTH WEEK—THURSDAY.

THE CORN-PLANTS.—THEIR MYSTERIOUS ORIGIN.

THE various productions which are the objects of culture, so far as the business of the agriculturist is concerned, may be divided into such vegetable substances as are fit for food, such as are employed in manufactures and the arts, and such as are used merely for the shelter and subdivision of the lands. In the earlier stages of agriculture, the first alone would be attended to; and of these the most important are the cereal plants, or the various kinds of grasses, known by the name of corn. These productions are not less agreeable to the palate than salubrious to the bodily health; and, while they thus indicate the paternal care of the great Creator, who has made so bountiful a provision for the wants and comforts of man, the circumstances which attend their propagation, afford instances equally striking, of a wise and liberal attention to the moral improvement of the human species. It is not merely that the possession of such grateful food essentially affects the extent of the population, as well as their health and animal vigour; but that the various employments necessary for its successful cultivation, have an obvious tendency to call forth and encourage the exertions of a virtuous industry. The crops of the sluggard are overrun with weeds, stunted in their growth, and deteriorated in their wholesomeness; while the labours of the diligent are rewarded, not only by a material augmentation in the quantity, but also by a not less remarkable enhancement in the quality, of the produce. In the evidence given by the Roman Catholic Bishop, Dr. Doyle, before the Committee of the House of Commons on the Irish

Poor, there is an instructive passage which bears on this subject, so far as regards the article of potatoes. He distinctly states, that in consequence of the slovenly manner in which that crop is cultivated by the labourers in the crowded districts of Ireland, a very striking change for the worse has taken place in the nutritive qualities of that useful plant. In this instance, peculiar circumstances have afforded an opportunity for making the observation, which seldom exist to the same extent elsewhere; but, if any one will take the trouble of inquiry, he will be surprised to discover how distinctly a similar effect is produced, both on grain and roots, in every part of the world where agriculture prevails.

To the plastic power of agricultural industry, in modifying and transforming the produce of the soil, we perhaps owe a remarkable fact of a different kind, which has deservedly attracted the attention of the students of nature. I allude to the circumstance, that no researches which have yet been made, have been able, distinctly, to trace the origin of the various species of grain now forming the staple of the agriculturist. There seems, indeed, good reason to believe, that nowhere on the face of the earth do any of them exist, in a wild state, with such properties as they possess under cultivation; unless, indeed, we make an exception in favour of Persia, where wheat has been found springing up spontaneously on spots now remote from human habitations—a remnant in all probability of the cultivation of ancient times. So true is this, that no surer indication can be found of the agency of civilized man, than the production of corn-plants, in any quarter of the world. Some species of cultivated grain, indeed, such as barley, are said to have been proved, by experiment, to be totally incapable of propagating themselves through a series of years, even under the most favourable circumstances;—a fact which, if it can be relied on, adds greatly to the mystery hanging over the original production of corn. Whatever light future discoveries may throw on this curious subject, it is impossible to view it without some degree of religious awe. Had the corn-plants been indigenous, or even had we been able to trace their

origin to distant climes, we might have been less deeply impressed with the agency of Heaven in bestowing these necessaries of life, and have regarded their cultivation as the mere ordinary effect of human industry; but it does throw a sacredness around the subject to be informed, that we possess these precious gifts, without being able, by natural means, to account for the manner in which they fell into our hands; that their very existence depends, year after year, on their cultivation; and that, should man cease, but for a short interval, to avail himself of the blessing, it is scarcely too much to aver, that the whole species of grain, with the exception, perhaps, of wheat in some peculiar circumstances, would perish from the face of the earth! When these facts are considered, it cannot be matter of surprise that, in all rude countries, traditions prevail, which attribute the origin of these necessaries to the direct interference of a divinity. Nor does it greatly lessen the admiration with which we contemplate this subject, to hear that attempts, some of which are said to have been partially successful, have been made, by scientific men, to transform certain wild grasses into cultivated corn. It may be true that the *Oegilops* of Sicily might, by careful and long cultivation, be changed into wheat; but this does not remove the mystery, even with regard to that single class. The question still recurs, by what remarkable incident, or rather series of incidents, in the earliest ages of the world, was this change effected, and by what extraordinary concurrence of circumstances was the discovery so carefully preserved, and so universally propagated.

We affect not to say, that the gift was miraculous, in the ordinary sense of that word; but we cannot resist the conclusion, that there is here conspicuously displayed the footsteps of a beneficent God. If, in the present advanced state of science, and of agricultural as well as commercial activity, there appears to be scarcely any means by which, on the supposition that all the grain now under actual cultivation were destroyed, the loss could be supplied from the common storehouse of nature, it cannot but be esteemed a cause of more

than ordinary gratitude to the Giver of all Good, that we have, in some mysterious way, been put in possession of articles of food so essential to human subsistence and happiness; and if it be also true, that the constant care of man is absolutely necessary, not merely for rendering this boon available for his use, but even for preserving it from almost certain annihilation, an additional force is given to the religious sentiment, which the contemplation is calculated to excite.

There is a natural infidelity of heart in man, which such facts tend to detect and to rebuke. In the more stable arrangements of Providence, if we may term them so, which do not at all depend on human exertions, we are apt to see nothing but the operation of mechanical powers. The grass springs spontaneously; the tree propagates its species by a natural process; the seasons revolve, and the ordinary fruits of the earth undergo a regular alternation of decay and reproduction, depending on what are called physical laws, certain and invariable in their operation, and altogether unconnected with human agency. These, though in reality not less indicative on that account, of Divine power and wisdom, yet, to a superficial observer, do not stand so prominently forward among the evidences of a superintending Providence, and he sees nothing in them, perhaps, but a curious train of natural sequences. The effect must be different, when we can demonstrate to him the astonishing fact, that the ordinary necessaries of life are maintained in existence by no such natural laws. That they neither exist, nor can be available, without the intervention of human industry; that, although assuredly not the creatures of man's invention, they depend entirely on his care for their preservation; and that thus, while there is, in the very constitution of the corn-plants, a proof of the curse which doomed man by a stern necessity to labour for his subsistence, there is also a proof, not less striking and conclusive, of the paternal tenderness which mingles favour with the chastisement, and from its very infliction elicits a reward.

TENTH WEEK—FRIDAY.

VEGETABLE SUBSTANCES.—THE CORN-PLANTS.—THEIR DISTRIBUTION OVER THE GLOBE.*

All vegetable productions, used as food, contain what is called a farinaceous, or mealy substance, admirably adapted for the support of animal life. This substance, indeed, serves in a greater or less degree, to form a constituent in all plants, and to be necessary to their growth. It has less of an organized structure than is discoverable in the membranous and fibrous portions of vegetables; and, when dry, may be converted into flour or meal. There are two kinds of vegetable substances which are best adapted for food, because, when ripe, they contain the greatest quantity of farinaceous matter; these are seeds and tuberous roots. It is of the former that I at present speak; and indeed of only one division of these productions, since that of *pulse*, or legumnious seeds, as well as of tubers, will form the subject of future consideration.

The corn-plants (*cerelia*), or grain-bearing plants, are true grasses, annual in their growth, having a hollow straw or culm, divided by joints or knots, and dying, both in the stems and roots, after the seed has ripened. The head or ear consists of an uncertain number of flowers, followed by seeds, and in these seeds the farinaceous food is deposited.

The chief corn-plants are wheat, rye, barley, oats, millet, rice, and maize; but there are other varieties, which might be employed as food, and which are only neglected on account of the smallness of their seeds. 'None are unwholesome in their natural state,' says Lindley, 'with the single exception of *Lolium temulentum* (darnel), a common weed in

* For the principal facts in these consecutive papers on Vegetable Substances, I am indebted to the elaborate and useful treatises on this subject, contained in the Library of Entertaining Knowledge, of which I have made free use. This acknowledgment will prevent the necessity of constant reference

many parts of England.'* The distribution of the above mentioned plants, over the various regions of the earth, as affording a proof of beneficent provision, shall form the subject of this paper.

None of the cereal plants seem capable of being raised to advantage in a higher latitude than about thirty degrees from the pole. This may, therefore, be considered as the limit of agricultural labour in the northern hemisphere, while, in that of the south, it is still more limited. Providence, however, has afforded other means of subsistence, as we have seen, to the living creatures who border on the polar circles, or who have penetrated within them. In Siberia, while grain is partially cultivated up to the sixtieth degree, the more southern districts of that extensive region, especially those which the Wolga waters, exhibit an extraordinary degree of fertility. Buckwheat is commonly raised in these parts, and it is found that one sowing of the seed will produce five or six crops in as many successive years; the seed which is shed during the reaping, sufficing to insure a crop in the subsequent season, without any manure, and with no more labour than that of harrowing the land in spring. The inhabitants are nevertheless poor, the means of commercial intercourse being extremely deficient.

Barley and oats are the kind of grain, the culture of which extends farthest to the north, in Europe. Rye follows next in order, being associated with oats and barley in the more northern division of the temperate zone. In the southern parts of Norway and Sweden, in Denmark, in districts bordering on the Baltic Sea, and in the north of Germany, rye forms the principal object of cultivation, barley being raised in those countries, as in England, only for the purpose of brewing, and the use of oats being limited principally to the feeding of horses. Wheat is also grown in those countries, but chiefly for exportation. In such northern regions, vegetation, when once commenced, proceeds with extraordinary rapidity. In Sweden and Norway, barley is generally sown

* Introduction to the Natural System of Botany, p. 302.

and reaped in the short space of sixty days; and, in some of the Norwegian provinces, that crop has been known to be fit for the sickle, even in six weeks after it was deposited in the ground.

Somewhat farther to the south, rye becomes more rare, and is succeeded by wheat as the principal material used for human food. France, England, the southern parts of Scotland, part of Germany, and Hungary, and the lands of Western and Middle Asia, as well as some districts of North America, fall under this description. In some of these countries, the vine is also cultivated, and the use of wine, instead of beer, causes the neglect of barley.

Still farther southward, maize and rice come into cultivation along with wheat, and enter largely into the constituents of human food. Portugal and Spain, that part of France which borders on the Mediterranean Sea, Italy, and Greece, are thus circumstanced.

Eastward, in Persia, Northern India, and Arabia, and southward in Nubia, Egypt, and Barbary, wheat is indeed found; but maize, rice, and millet, form the principal materials for human subsistence. The grains which form the chief objects of cultivation in our division of the globe, are rarely seen in China and Japan, owing, it is believed, more to the taste of the inhabitants, than the character of the soil and climate. There, the staple production for food is rice. In that empire, agriculture is greatly encouraged; and even the emperors of China have not disdained to hold the plough, and place their fame on the basis of agricultural improvements. The well-known denseness of the population in these regions may be considered as both the cause and the consequence of this feature in the national character.

Of the countries which lie between the tropics, those of Asia adopted principally the use of rice, while maize is the common food of the Americans. For this distribution there exists a natural reason,—Asia being the native region of rice, while America is that of maize. In mosts parts of Africa,

the two grains are used indifferently, and in nearly equal proportions.

In America, which comprises climates analogous to those in every other quarter of the globe, we find all the varieties of grain culture I have already enumerated. The highest limit for the cultivation of the cereal plants is to be found in the southern part of the Russian possessions in that great continent, situated between 57° and 58° of north latitude, where barley and rye are brought to maturity. In the more eastern parts, the same cultivation rarely succeeds higher than 50° or 51°. In Canada, and in the northern parts of the United States, barley, oats, rye, and wheat, may be cultivated as successfully as in Europe; but the agriculture is much more slovenly, owing, doubtless, to the extent of thinly peopled territory. Maize, and in the southern parts, rice, are very extensively raised within the bounds of the Union.

On the table-land in southern latitudes of the Mexican Republic, the corn-plants of Europe are cultivated, but never at a lower elevation above the level of the sea than 2500 or 3000 feet. In the regions of Mexico, of a lower level, maize is extensively raised; and, from the nature of the climate, and the fertility of the soil, the returns are most abundant, sometimes yielding a harvest of two hundred for one.

In the temperate and polar districts of the southern hemisphere, the order of cultivation is very similar to that pursued in corresponding latitudes and elevations north of the tropics. In the southern provinces of Brazil, in Buenos Ayres, and in Chili, as well as at the Cape of Good Hope, and among the settlers in Australia, wheat forms the principal object of cultivation. In Van Dieman's Land, barley, rye, and oats, are also to be found.

This hasty sketch may serve to show, without any remark, how beneficently the Creator has suited some one or other of the various kinds of grain to all the productive climates of the earth, and how remarkably the constitution of each is adapted to its own locality, the one class intermingling with the other at the various lines of contact, so as to leave no region of the

earth without its wholesome and appropriate food. This will appear more distinctly, in treating of each species separately.

TENTH WEEK—SATURDAY.

THE CORN-PLANTS.—WHEAT.

The nature of this work will only admit of some slight notices of the most remarkable articles of agricultural produce; and of these I begin with wheat, as the species of grain held in highest and most general estimation.

The peculiar property on which the value of this plant depends, next to the quantity of farinaceous food which the seed contains, is its extraordinary power of multiplication, increasing in proportion to the care employed in its cultivation. In the Philosophical Transactions,* it is recorded, that Mr. C. Miller of Cambridge sowed, on the 2d of June, a few grains of common red wheat, one of the plants from which had tillered† so much that on the 8th of August he was enabled to divide it into eighteen parts, all of which were placed separately in the ground. In the course of September and October, so many of these had again multiplied their stalks, that the number of plants which were separately set out to stand the winter, was sixty-seven. With the first growth of the spring the tillering again went forward, so that, at the end of March and beginning of April, a further division was made, and the number of plants now amounted to 500. Mr. Miller thought that before the season had too far advanced, another division might have been made, when the number would have been at least quadrupled. This, however, was

* Vol. lviii.

† To *tiller*, technically signifies to throw out stalks, not from the germ, but from various points of the infant sprouts, while yet they remain in contact with the moist soil.

not done; but the 500 plants proved extremely vigorous, much more so than wheat under ordinary culture, so that the number of ears submitted to the sickle was 21,109, or more than forty to each of the divided plants. In some instances there were not fewer than 100 ears on one plant. The ears were remarkably fine, some being six or seven inches long, and containing from sixty to seventy grains. The wheat, when separated from the straw, weighed 47 lb. 7 oz., and measured three pecks and three-quarters, the estimated number of grains being 576,840.

Such an enormus increase is not, of course, attainable on any great scale, or by the common modes of culture. But the experiment serves to show the vast power of reproduction with which the Creator has endowed this most valuable of vegetables; and leads us to comprehend, how, by judiciously varying the mode of culture, the produce may be rendered more adequate to supply the wants of a growing population; or, at all events, how, under some peculiar circumstances, such as that of a ship's crew being cast on a desert island, the possession of a single grain of wheat may, in a very few seasons, be made to contribute to the support and comfort of a considerable number of individuals.

The ordinary produce of wheat varies exceedingly, being made to depend, not merely on the quality of the soil, and the nature of the season, but on the mode of culture,—a provision intended, doubtless, to stimulate and reward industrious habits. The average production of the soil, in any country, depends on the advance of its inhabitants in knowledge, and in the possession of capital. It has been conjectured, that, in the thirteenth century, an acre of good land in England would produce twelve bushels of wheat.* In two centuries, this rate of produce appears to have greatly increased. Harrison, writing in 1574, says, that on an average,† 'each acre of rye or wheat, well tilled and dressed, will yield commonly sixteen

* Eden's History of the Poor, vol. i. p. 18.

† This I understand by what he calls 'meane and indifferent years,' signifying, in more modern language, medium and common years.

or twenty bushels; an acre of barley six-and-thirty bushels; of oats and such like, four or five quarters; which proportion is notwithstanding oft abated towards the north, as it is oftentimes surmounted in the south.' The mean produce, in Great Britain, did not, according to the estimate of Mr. Arthur Young, when he wrote (about half a century ago), exceed twenty-two and a half bushels per acre. It is constantly on the increase, and other and later writers have calculated the average at from twenty-four to twenty-eight bushels.

At the time of the Revolution, according to the estimate of Gregory King, fourteen millions bushels of wheat were grown in England. In 1828, according to the estimate of Mr. Jacob, in his tracts on the Corn Trade, twelve millions five hundred thousand quarters, or a hundred million bushels were grown. The population of England, at the Revolution, was under five millions, so that each person consumed about three bushels annually. The population, at the present time, is under fifteen millions, so that each person consumes about seven bushels annually.

Extraordinary success in agricultural labours has sometimes been the means of exciting, not only the envy, but the superstition of a neighbourhood. A case of this kind is related by Pliny, as having occurred among the Romans. Cresinus, he tells us, was cited before an assembly of the people, to answer to a charge of sorcery, founded on his reaping much larger crops than others, from a small spot of ground. 'In answer to this charge, Cresinus produced his efficient implements of husbandry, his well-fed oxen, and a hale young woman, his daughter, and pointing to them, he exclaimed, "These, Romans, are my instruments of witchcraft; but I cannot here show you my labours, sweats, and anxious cares." '*

We have seen how wheat is multiplied by means of tillering, an operation which takes place under ground; and I cannot help mentioning a curious fact, with reference to this subject, which seems to discover a new and remarkable adaptation

* Nat. Hist., book xviii. chap. vi.

between the vegetable and animal world. There is an insect,* which is accustomed to deposit its eggs in the very core of the *plumula*, or primary shoot of wheat, so that this shoot is completely destroyed by the larvæ. Did the plant possess, within itself, no means of repairing this injury, the whole previous labour of the husbandman would, in this case, have been in vain. But this destruction occurring in the spring of the year, when the vegetable power of the plant is in its greatest vigour, an effect is produced, somewhat analogous to that of heading down a fruit tree. Shoots immediately spring up from the knots; the plant becomes more firmly rooted, and produces probably a dozen stems and ears, when, but for the temporary mischief, it might have sent forth one only.

There is here a most curious and beneficent deviation from the ordinary law by which Creative Wisdom seems to have been actuated in the formation of the insect, and, indeed, I may say of the whole animal world. That law is, that, while the living creature finds subsistence for itself in the vegetable kingdom, it should tend to preserve the balance among its various productions, by the destruction, or at least injury, of the plant on which it feeds. Here, however, the very reverse is the case; and a similar remark may be made with regard to the various grasses, which form the food of herbivorous quadrupeds. The grazing of these animals, though it destroys the seed-stalk, causes the plant to tiller, and thus compensates for the loss sustained in the power of propagation, by forming on the spot a firm, sweet, and luxuriant sward of herbage.

That the very same law, which keeps in check other vegetable substances, should be made subservient to the increase of those which are of essential importance to the subsistence of the higher species of animals, is a benevolent intention, which cannot be mistaken, and which it is impossible to perceive, without admiration.

* Musca pumilionis.

ELEVENTH WEEK—SUNDAY.

SABBATH MORNING.

THERE is no season more welcome to the Christian, than the dawning of the day of rest; none that is ushered in with more reviving associations.

The sun, drawing up the soft vapours of morning, seems to shine with a more cheering light on the day that saw the rising of the Sun of righteousness. The moist green turf, spread as a carpet over hill and dale, catches the bright reflection, and returns a grateful smile; while the clustering wild-flowers that spring from its shelter, show forth the beneficence that did not scorn to fashion their short-lived beauty. The breezy air seems to breathe the messages of gentleness and mercy from forgiving Heaven; and the earth, once smitten with a curse for the sin of man, seems to partake in the reconciliation that was completed on the Saviour's resurrection morn. The fields and the woods send up their sweetest incense, and the trees rustle, and the waters murmur, praise. Spring, the season of Nature's hope, brings not so bright a day as this, the time of peculiar and more enduring hope to the Christian. As his eye rests on each feature of the scene, his heart becomes filled with its serenity. and he exults in the service of so gracious a Master. If he sees love in the colouring of the landscape, and the arching of the sky, how unspeakably greater does that appear which rescued him from destruction, and adorned his fallen and polluted soul with the spotless robe of imputed righteousness. Corrupted, and at enmity with God, it was gently drawn from the brink of ruin, and was purified and formed anew, while it wondered and gave thanks at the mighty work of the Divine Spirit. Of the same love, the institution of the sacred day is a rich token. Like the gourd that sprung up to shelter Jonah from the scorching heat, the services of the sanctuary have been

prepared for the refreshment of the heaven-bound pilgrim;—but not, like it, to perish in a night: For, ever, as the first day of the week returns, are these solemnities renewed, and their hallowed influence is felt to extend over each intervening day. The prospect of a day spent in the courts of God, sheds a tranquil joy through the soul, and calls forth the fervent exclamation, 'How amiable are thy tabernacles, O Lord of Hosts!' And what the heart desires, it seeks with earnestness from Him whose presence alone makes glorious the places of His rest on earth.

And shall the morning contemplation cease here? Shall the Christian, absorbed in his own joyful prospects, forget the multitudes to whom the Sabbath brings no joy? Never does their wretched state come with more energy to his mind, than in that hour of thankful peace. In proportion to the vividness of his own hope, is his conviction of the awful hopelessness of the unconverted. He mourns for the many who live like him under the shadow of the Cross, but cling not to it;—the many who are led to the streams of Gospel privilege, but will not drink, and live. To them the Sabbath is a weariness; they go up to the sanctuary with indifference, and leave it without profit. Years are rolling on, and soon their places will be vacant; and soon again they will be filled by another generation. And where will be those who have despised the offers of pardon, and refused to hearken to the reiterated calls of mercy? As the Christian muses on these things, he is stimulated to arise and be doing, while yet it is his privilege to sojourn where a work so vast and so important lies before him. Is it time to rest in his own happiness, or to seek his own honour, when souls are perishing? It would be greater joy to him to win one rebel back to his allegiance, than to attract the admiring gaze of nations, or to be crowned with the freshest laurels that ever bound the brow of a Cæsar.

Those, too, he remembers, more ignorant, but less guilty than the former, who dwell far off on the islands of the sea, or in regions of unexplored darkness, in the burning deserts of Africa, or among the tangled forests of the West. On

them the morning sun may arise in his glory, but it is only to light them onward in a course of sin. Spring may spread her most luxuriant wreaths around their rude dwellings, but the desolation of unbroken winter broods on their immortal souls. The trees of the forest, or the caverns that shelter the beasts of the earth, furnish them with nutritious food; it was provided by no skill of theirs; but they know not the hand that maintains the ready supply,—they see not the traces of Him whose paths drop fatness. In their ignorance they give thanks to dumb idols, and in their deep groves, or by their silvery streams, to them present their offerings; but these cannot hear their cry in the hour of their anguish, or illumine for them the gloom of a dark, unknown eternity. The Sabbath passes and returns, but brings no rest to them. There is no early bell to call them to the house of prayer, no faithful shepherd to collect the flock,—the beautiful flock,—who are scattered through the wilderness, an easy prey to the devouring Lion. It is the hour of that Lion's exultation, and he deems the empire all his own; ages have mingled with eternity, and yet, mysterious dispensation! his terrible sway has not been broken down. But the day approaches; for these benighted ones are precious in the sight of Him who feeds the ravens when they cry, and He will come in His might, to make the crooked places straight before them. The Christian has been furnished with a powerful engine to accelerate that day; and he whose bosom glows with heavenly zeal, will never cease to use it. He will offer many prayers on the altar of the covenant, and, in due time, all shall receive an answer, even tenfold more than his heart could conceive. Taught, by a Saviour's love, to pity the perishing, he will, as He did, entreat the Father for them, and strive to excite in others a corresponding fervour, that all, uniting under the banner of the cross, may spread the glad tidings of salvation over the length and breadth of a ransomed, but still enfettered world.

True religion is not selfish; it expands the heart to love, and nerves the frame to action; and the Christian goes forth

from the hour of Sabbath meditation, humbled under a sense of undeserved mercies; and, while he clings to them more closely than ever, resolves, in the Divine strength, to spare neither time nor exertion to diffuse them among his famishing brethren, that the sons of Adam, in every land, may rejoice at the coming of the day of rest, and may attain to the animating, the imperishable hope of 'rest from their labours,' in 'the city that has no need of the sun nor of the moon to enlighten it.' M. L. D.

ELEVENTH WEEK—MONDAY.

THE CORN-PLANTS.—BARLEY.

Barley is, next to wheat, the most important, in a general point of view, of all the cereal grains which are cultivated in temperate climates, though, as far as relates to this country, it may be considered rather as a luxury than a necessary of life, being chiefly used for the purpose of producing fermented liquors. It is, in one respect, indeed, more useful than wheat. It may be propagated over a wider range of climate, bearing heat and drought more patiently, growing on lighter soils, and coming so quickly to maturity, that the short northern summers, which do not admit of the ripening of wheat, are yet of long enough duration for the perfection of this plant. It is the latest sown, and the earliest reaped, of all the summer grains. In warm countries, such as Spain, the farmers can gather two harvests of barley within the year,—one in the spring, from winter-sown grain, and the other in autumn, from that sown in summer.

Barley sown in June, is commonly ready for the sickle in three months after the seed has been committed to the ground; and, in very northern climates, the period necessary for its growth, as we remarked in a former paper, is of still shorter duration. Linnæus relates, in his tour in Lulean Lapland, that, on 28th July, he observed the commencement of the

barley harvest, and, although the seed had been sown only a few days before midsummer, that the grain was perfectly ripe, the whole process having thus occupied certainly not longer than six weeks.

The property of requiring little moisture, as well as of rapid growth, admirably fits barley for propagation in those northern countries, where the duration of summer is limited to a very few months in the year, and where wet is of very rare occurrence, from the time when the spring rains are over, at the end of May, or beginning of June, until the autumnal equinox, previous to which the harvest is reaped.

So hurtful is excessive moisture to the barley plants, that even heavy dews, if of frequent occurrence, are said to be injurious. Much wet is detrimental at all periods; but the mischief is exhibited in a very different manner, according as it occurs before or after the formation of the ear: If it happen during the former stage, the leaves will become yellow and sickly, and the ears will perhaps not make their appearance; whereas, if the ears have already been formed and completely filled, the grain, when visited by long continued falls of rain, will sprout; and, should the weather which follows be warm and genial, this growth will be so rapid, that the ears will put on the appearance of tufts of grass. Gentle showers, however, if of short continuance, and if they do not happen either very early after the plant is above ground, or during the time of blooming, or when the ear is full, are beneficial.

In its composition, barley differs materially from wheat; it contains more starch, far less gluten, and about seven parts in a hundred of saccharine matter, ready formed, which latter constituent wheat does not possess previous to germination.

Botanical writers enumerate four distinct species of barley; of these there are many varieties, produced by differences of soil, climate, and culture. Spring barley is the kind most commonly cultivated in Britain. In the more northern countries, and in the north of Scotland, square barley or bear, called also big, is in particular districts raised in preference, this being a much more hardy, though a coarser plant. The number of grains in

each ear is greater than is found on spring barley, in the proportion of three to two,—one ear frequently yielding forty or more grains. These are disposed in six rows. The other two varieties are the long-eared and the sprat-barley. Of the former it may be stated, that it possesses some peculiar good qualities, the husk being thin, and its capacity for malting being much esteemed;—of the latter, that the ears are broader than those of the others, and the straw so much shorter and coarser, as to render it not desirable for fodder. Besides these there is a variety lately introduced, called Chevalier barley, from the name of the agriculturist who has paid particular attention to its cultivation, which, though somewhat later than the common barley, has some excellent qualities, likely to recommend it to general culture.

The use of barley in the preparation of a fermented liquor dates from the very remotest times. The invention of this preparation is ascribed to the Egyptians by ancient Greek writers. Herodotus, in particular, expressly states, that the people of Egypt, being without vines, made their wines from barley.* This liquor is called *Zythum* by Pliny, but whether it was ale or ardent spirits, does not seem to be certainly known. An intoxicating liquid is still made from barley, both in Egypt and Nubia, to which the natives give the name of *bouzah*,—a word from which the English term to *bouse* is probably derived, through the medium of the Dutch. From a passage in Tacitus, it appears that the Germans were in his day acquainted with the art of preparing beer from malted grain; and Pliny describes a similar liquor under the name of *Cirevisia*. It further appears, that malt liquor has formed an article of manufacture and consumption in this country, from a period at least coeval with the time of Tacitus. It was not, however, till a comparatively modern date, that hops were used in the composition of ale.†

Of barley, there are above thirty millions of bushels con-

* Lib. ii. cap. 78.

† Henry VIII. forbade brewers to put hops and sulphur into ale; but, in the fifth year of Edward VI., privileges were granted to hop grounds.

verted into malt in Great Britain, and more than eight million barrels of beer, of which four-fifths are strong beer, are brewed annually.

That the process of fermentation is one of the powers of Nature, intended by Heaven for the benefit of the human race, cannot reasonably be doubted; and that, when used with discretion, it has largely contributed to increase their comfort, and add to their medicinal resources, is equally true; but such is the unhappy tendency of our fallen nature to abuse the gifts of the Creator, that, were the balance fairly struck between the practical advantages and evils of this provision, as they have hitherto been exhibited in society, I have no hesitation in saying, that it would be found to have proved a curse instead of a blessing.* This, however, is nothing more than may be stated of many other beneficent provisions of Providence, and affords only another proof of the abuse of our mental liberty, of the degradation of our nature, and of the state of discipline in which we have been consequently placed. Speaking of the moral world, we are told in the Divine Record, that 'God made man upright, but he has found out for himself many inventions;' and it is not less true of the physical world, that all the gifts of the Creator are in themselves excellent, but man has too often perverted and abused them to his ruin.

* This abuse has a tendency to correct itself. In America, where the vice of drunkenness was carried to a greater excess than perhaps in any other quarter of the civilized world, Temperance Societies have arisen, occasioned by a re-action, and the influence of Christian principle. There are in that country upwards of a thousand of these societies in operation, consisting of 100,000 members. The practical good effected by these institutions, is beyond all praise. Into Britain, also, they have lately been introduced; but they have not yet received the public support which their importance deserves.

ELEVENTH WEEK—TUESDAY.

THE CORN-PLANTS.—OATS.

The native place of oats is supposed to have been in a more northern climate than that of the other cereal plants, since it cannot be cultivated to advantage in the lower latitudes of the temperate zone. In the south of England, even at high elevations, the produce is inferior in quality to that which is obtained in districts nearer the polar circle.

This grain is extremely serviceable to man, possessing the advantage of growing upon soils, and in situations, where neither barley nor wheat can be raised. It is the hardiest of all the cereal grains cultivated in Great Britain.

In its outward structure, the oat plant differs from wheat and barley in the form of the ear. This, in oats, is not a spike,* with a single rachis, but a panicle,† containing a stalk and branches. While young and light, these branches arrange themselves round the centre of the stem; but, as they advance towards maturity, and acquire weight, they generally bend over on one side. By this arrangement, the air and light are enabled to visit, and the rain to wash, each individual grain, so that any lodgement of the larvæ of insects on the seeds, or of parasitical plants, is rendered difficult. The grains being pendent, and having the open extremity of the chaff towards the earth, are effectually defended from the lodgement of rain within,—an advantage which does not belong to the growth of wheat or barley, and these latter grains are consequently liable to diseases, especially in rainy climates, from which oats are exempted. Drought and heat, on the other hand, are unfavourable to this grain, which, under such

* Spike, in botany, is so called, where many flowers or seeds sit on a simple filiform flower-stalk, as in wheat and barley.

† Panicle is the name given, where many simple flowers or seeds stand on unequal branches, and a long flower-stalk

circumstances, become husky, containing but little farinaceous matter, and that being of inferior quality.

There are several varieties of oats, commonly cultivated in this country. Of these, the most remarkable are the black or long-bearded, the white, the red, the naked, the Highland early, the Churches, and the potato oat. The last mentioned is generally esteemed the most valuable, though of late years it has shown a tendency to degenerate. Of this kind, the first plants were discovered growing accidentally on a heap of manure, in company with several potato-plants; and it is to this circumstance that the distinctive name of the variety is owing. To an occurrence thus accidental, we are indebted for a kind of this useful grain, which, for nearly half a century, has been considered as the most profitable in existence. It requires to be sown on land in a good state of cultivation; when the grains will be found large, plump, and firm. The straw of the potato-oat is also of excellent quality. It is the variety most generally cultivated in the north of England, and in the lower districts of Scotland.

The seed time of oats is almost universally in March and April. The grain is scattered broadcast, in the large proportion of from four to six bushels to the acre,—the medium produce of which is from forty to fifty bushels.

The nutritive quality of oats is less, in a given weight, than that of any other of the cereal grains. In oats of the best quality, it does not exceed 75 per cent.; while that of wheat is 95½ per cent. The very small proportion of saccharine matter ready formed in oats, renders it both difficult and unprofitable to convert this grain into malt. Brewers at the present day, therefore, do not employ oats in the preparation of any kind of beer. In former times, when the public taste was different from what it is at present, a drink called *mum* was manufactured for sale, and in the preparation of this liquid, oatmeal was employed.

There is a kind of weed, called the wild oat, indigenous to this country, which, though it resembles the cultivated species in form, differs from it altogether in its qualities. Its

seed is exceedingly tenacious of life, and will remain buried under the soil for a century or more, without losing its vegetating power. Such a property in seeds, as I observed in the Winter volume, is very far from being uncommon.

Before leaving the subject of the corn-plants cultivated in our own latitudes, let us reflect for a moment on this bountiful provision of Creative wisdom. In a grain of corn, at one end of a groove, is a small protuberance, which is the germ or embryo of the future plant. This organ has been appropriately called *corculum*, or little heart. It contains within itself a principle, which, by being placed in the earth, and subjected to the influence of the seasons, evolves first a sprout, then a stalk with leaves and joints, and then, on the top of all, exposed in the most favourable manner to the action of the sun and air, a number of seeds, the whole of which productions, both in their early and mature state, are fit for the food of useful quadrupeds, while the seeds contain a farina admirably adapted for the nutriment of the human species.

Look, again, at the manner in which this important gift is propagated. It produces not only a plant, with its farinaceous seed; but, yielding a ready return to human industry and skill, it affords plants after plants, and seeds after seeds, in such abundance, that, in the course of a few harvests, the progeny of a single little germ might be rendered capable of feeding a nation. 'Thus it is,' says the author of the articles on Vegetable Substances, in the Library of Entertaining Knowledge, 'that in the lapse of ages, amidst the desolations of rude conquerors, and the alternations which the finest portions of the earth have endured, from civilization to semi-barbarism, the vital principle of vegetable life, destined for the chief support of the human race, has not been lost; and it has remained to man, like fire, which he alone has subjected to his use, to be called forth at his bidding to administer to his support, his comfort, and his advancement, in every art of social existence.'*

* Vegetable Substances, p. 40.

There is something very striking in the fact, that while conquest carries extermination over the face of the earth, it is also one of the frequent means employed by Providence for diffusing the blessing of useful plants among rude nations, as well as various other comforts of civilized society. Connected with this subject, it is exceedingly affecting to think that the value of decaying organized substances, as manure, may perhaps first have been taught to a savage people, by observing the effects produced by this process on a field of battle. This idea has been suggested by the following observations of an amiable and talented traveller, on the field of Waterloo. 'As I looked over this field, now green with growing corn, I could mark with my eye spots where the most desperate carnage had been, pointed out by the verdure of the wheat. This touching memorial, which endures when the thousand groans have expired, and when the stain of human blood has faded from the ground, still seems to cry to heaven that there is awful guilt somewhere, and a terrific reckoning for those who had caused destruction which the earth would not conceal. These hillocks of superabundant vegetation, as the wind rustled through the corn, seemed the most affecting monuments which Nature could devise, and gave a melancholy animation to the plain of death.'*

ELEVENTH WEEK—WEDNESDAY.

THE CORN-PLANTS.—RICE, MAIZE, AND MILLET.

In approaching the tropical regions, all the kinds of grain already treated of gradually disappear, and rice, maize, and millet, are cultivated in their place. These plants are obviously formed for occupying, with wholesome food, each in its own peculiar region, the extensive plains and rising grounds of the equatorial portions of the globe,—the rice affecting the low swampy lands on the banks of the rivers and streams,—the

* 'Essays Descriptive and Moral, by an American.'

maize also requiring moisture, but in a much smaller proportion,—and the millet being an inhabitant of light sandy soils, exposed, without mitigation, to the scorching rays of the sun.

Of rice itself, indeed, there are varieties, which almost render it fit for any state of moisture. The *common* and the *early* rice are both marsh plants, but the *mountain* rice thrives on the slopes of hills and in other situations where it can receive humidity only occasionally, and the *clammy* rice appears to be endowed with the peculiar property of growing both on wet and on dry grounds. The species chiefly cultivated, however, requires much moisture; and in almost all parts of the world where it is raised, the practice of irrigation has been adopted.

Rice is a panicled grass. The seed grows on separate footstalks, springing from the stem. Each grain is terminated by an awn or beard, and enclosed in a rough yellow husk, the whole forming a spiked panicle. The stalk is not unlike that of wheat, but the joints are more numerous.

The farina of rice is almost entirely composed of starch, having little or no gluten, and being without any ready formed saccharine matter. On account of this difference of composition, it is believed to be much less nutritious than the corn-plants already described.

There is little reason for doubting that this grain is of Asiatic origin. From the earliest records, it has formed the principal, if not almost the only food of the great mass of the population on the continent and in the islands of India, as well as throughout the Chinese empire. The introduction of it into America, where it is now so extensively cultivated, is of recent date. It is said, that about the end of the century before last, a brigantine from the island of Madagascar happened to put in at Carolina, having a little seed rice, which the captain gave to a gentleman of the name of Woodward. This he sowed; and as it was productive, it soon became dispersed over the province. It is reported also, that Mr. Dubois, Treasurer of the East India Company, about the same time, sent a small bag of rice-seed to that country; and from

these two parcels, it is supposed, that the two kinds, the red and the white, now raised in America, took their rise.

The swamps of South Carolina, both those which are occasioned by the periodical visitings of the tides, and those which are caused by the inland floodings of the rivers, are found to be well suited to the production of rice; and not only is the cultivation accomplished with little labour, but the grain proves of a remarkably fine quality. It is, in that part of the American States, extensively cultivated for exportation.

In some parts of Europe, and, in particular, on the rich meadows of Lombardy, which can be irrigated by the waters of the Po, and in the Province of Valencia, in Spain, where there are similar facilities, rice is successfully cultivated; but the effects of the flooding is found in Lombardy to be so detrimental to health, that the government has thought it necessary to restrict this profitable species of agriculture within certain limits.

Although rice be exceedingly prolific, it has been remarked, that it has a tendency rather to condemn the great body of the inhabitants to poverty, than to prove a source of riches, in those countries where it forms the sole article of food. The reason for this it is not difficult to discover. The people obtaining the bare means of subsistence, without laborious exertion, are destitute of those incentives to industry which so powerfully and so beneficially actuate the lower classes of the community in such countries as our own, and which infuse such life and vigour into all the various grades of society. Their native indolence restrains their activity; and in ordinary years, luxuriating in abundance, they are contented with the present, and form no schemes for the future. It is remarkable, however, that in such countries visitations of famine are both more common and more destructive than in those regions of the globe which are naturally less prolific. This is owing not merely to the want of provident habits in the inhabitants, but also to the circumstance of their entire dependance on one article of food. When a failure in their rice

crop occurs, they have no other kind of sustenance to fall back upon. The misery of their condition in this respect may be readily understood, by supposing what would be the state of our own poor if they depended solely for support on potatoes. That crop, from whatever cause, has showed for several years a tendency to failure in its prolific powers. It is frightful to think of the misery which must have ensued, had not a mitigation of the evil been found in the comparative abundance of the various kinds of grain, in which the labouring classes are enabled to find a substitute. In considering this subject, we shall find a confirmation of the reasoning contained in previous papers, as to the wisdom and beneficence of that providential arrangement, which has made hard labour, in by far the greatest variety of cases, essential as the means of procuring the common necessaries of life.

On the other kinds of grain which a beneficent Creator has granted to the inhabitants of the warmer regions of the earth, it does not seem necessary to say much. The plant of Indian corn or maize, consists of a strong, reedy, jointed stalk, provided with large flag-like leaves, and surmounted with hard seeds, growing round a cylindrical pith or *cobb*, and enveloped in a husk. It is said to contain no gluten, and little, if any saccharine matter, whence it has been asserted to have but small nutritive power. This theoretical conclusion is, however, contradicted by experience, as domestic animals, of every description, when fed on it, speedily become fat, their flesh being at the same time remarkably firm; and the common people of countries where this grain forms the ordinary food, are for the most part strong and hardy races. The produce of maize, on a given extent of cultivation, is greater than that of any other grain; and the proportional return for a given quantity of seed is equally advantageous. Perhaps it might be usefully introduced into this country as a green crop; but the experiments which have been made, notwithstanding the strong assertions of Mr. Cobbett to the contrary, seem to prove, that in our climate the seeds do not, in ordinary years, come to maturity.

Millet, the smallest of all the cereal seeds cultivated for food, grows on arid soils, where rice and maize cannot be successfully cultivated, and forms the chief subsistence of the people in some parts of India, through the sandy districts of Arabia, in Syria, where it has been produced from the earliest periods, and in Nubia, where the inhabitants cultivate this almost to the exclusion of every other species of grain.

A hardy variety of this plant is also grown in Germany, and was introduced into Switzerland by M. Tschiffeli, about the middle of last century. This gentleman has published an account of his method of cultivation, in the Transactions of the Berne Society, in which he strongly recommends it to the attention of agriculturists. Among the advantages which it offers, are stated, its adaptation to all sorts of soils, the small quantity of manure which it requires, the trifling amount of labour for which it calls, and the small degree of exhaustion which it occasions to the soil, in comparison to the largeness of the return which it yields. These are great recommendations; but it is believed, that, in Britain, the climate is not sufficiently warm and dry for ripening the seeds.

ELEVENTH WEEK—THURSDAY.

LEGUMINOUS PLANTS.—PEAS AND BEANS.

Pulse, or the legumes, are a numerous class of vegetable productions, widely diffused over the globe, several of which were very early made articles of cultivation. Of these the pea and the bean, which are in most common use, shall form the subject of a short notice in this paper.

The whole of the edible legumes, with the exception of some of the species which grow on trees, have their flowers papilionaceous, or, in shape, resembling butterflies. The seeds are contained in an oblong pod, consisting of two valves, on the upper suture of which they are placed alternately on

each side. These seeds, in germinating, push forth only one stem, so that they do not tiller, like the corn-plants, but the buds on the stem produce fertile branches. All the kinds afford much less nutritive matter than the *cerealia*.

Peas contain fifty-seven and a half per cent. of nutritive matter, a proportion of which is saccharine. Beans have very nearly as much nutriment, but it is not entirely composed of the same principles. No saccharine matter, ready formed, is found in this vegetable, which is considered coarse, but nutritive.

The pea is a climbing plant, furnished with tendrils at the terminations of the compound leaves. The varieties are very numerous. Of the common pea, the principal varieties are the white or yellow, and the grey. The sub-varieties are never ending. Of these, no fewer than twenty-two have been enumerated as objects of garden culture, differing in the colour of the flowers, the height of the stalk, the time of coming to maturity, the produce of the pods, or the size or flavour of the seeds. There is a difference, also, in the degrees of tenderness and hardihood, which fit them for different exposures, and in the richness or poverty of the soil they demand, which requires a variety in the mode of cultivation. All these circumstances, which have been probably produced by various modes of treatment, are calculated to exercise the skill of the cultivator, and to afford a stimulus to his discriminating industry.

The native country of the common pea is not known, as it was a cultivated vegetable before the commencement of botanical history. It is probable, however, that it was introduced into Britain from the warmer parts of Europe, and may have been brought to these from Egypt and Syria. It is known in India, China, and Cochin China, but it is not very plentiful in those places, and there is no evidence of its being a native plant. It is more abundant in the Japan Isles, the climate and soil of which appear to agree better with its habits. It seems equally to droop under the extremes of heat and cold; and we may therefore conclude, that it has taken

its origin in some of the warmer latitudes of the temperate zone.

Historical evidence would make it appear that both the pea and the bean must not only have been introduced, but must have been extensively cultivated, in some parts of Scotland, as well as in England, at a very early period. It is on record, that when the English forces were besieging a castle in Lothian, in the year 1299, their supply of provisions was exhausted, and their only resource was in the peas and beans of the surrounding fields. This circumstance seems to lead to the belief, that these plants were then raised extensively as articles of common food. Fuller, however, mentions that peas were brought from Holland, in the time of Queen Elizabeth, which were 'fit dainties for ladies, they came so far, and cost so dear;'—this must allude to some more delicate kinds which had not even at that comparatively late period been introduced into the British gardens.

Peas are at present annually cultivated to a great extent in Britain, though their use has been considerably circumscribed by the introduction of potatoes. They are consumed in immense quantities as sea provisions; they are in familiar use in families; and they furnish a valuable food for horses.

The bean is supposed to have been introduced into this country by the Romans. The Greeks were of opinion that its native country was Egypt, perhaps because they received it for cultivation from that country. Some travellers assure us that the bean is found growing wild in Persia, near the shores of the Caspian Sea; but that part of Asia has been subjected to so many fluctuations, so many alternations of culture and destruction, that it is not easy to decide how far any plants, which may there be discovered vegetating spontaneously, are really indigenous, or only the remains of a former cultivation.

Beans are cultivated over many countries, as far to the eastward as China and Japan; and in many parts of Africa they are extensively used as an esculent. From the northern coast of this continent, some of the most valuable varieties

were transplanted by the Moors into Spain, and by the Portuguese into their own country.

The bean is only used in this country for culinary purposes in a green state; when mature and dried, it is considered as a useful food for horses. King stated the annual consumption in this country, about the middle of last century, to be of beans four millions of bushels, and of peas seven millions. This is a large consumption for that period; but the accuracy of the statement has been doubted, though, certainly, a very considerable exportation of horse beans was at that time made, for the use of the negroes in our plantations.

All the cultivated beans are annuals, having upright fibrous stems, rising from two to four feet high. The flowers are usually white, with a black spot in the middle of the wing. These are succeeded by long thick pods, woolly within, and enclosing flat seeds. The flowers are very fragrant, and the rich perfume of a bean-field, when the plants are in full blossom, is as familiar as it is delightful to all lovers of simple rural pleasures.

There is another species of this plant, called the kidney-bean, some varieties of which are found in cultivation throughout almost every civilized country of the western, as well as the eastern, hemisphere. In England only the immature pod is used for food; but in France, the ripe seeds known by the name of *haricots*, are prepared in various ways as a favourite edible. A variety of this bean, called *fricolli*, is in general demand all over Mexico.

The stems of the kidney-bean, are, in all the varieties, more or less voluble, and contrary to the ordinary law of Nature, instead of turning in the direction of the sun, turn in a contrary direction. To account for this, it has been supposed that the native place of this plant is on the southern side of the equator, and that the plant, though through so many generations removed to the north, 'is still obedient to the course originally assigned to it, turning in a direction which, in its native climate, would be towards the sun.'* Should this

* Loudon's Encyclopedia of Gardening, p. 694.

prove to be the case, which the analogy of nature renders very probable, it furnishes a remarkable confirmation of a fact supported by many proofs, that the Creator has impressed, not merely a certain constitution, but certain habits on plants, corresponding to the localities in which they were intended to grow, originally independent of external stimuli, and sometimes, as in the present instance, unaffectable by them.

ELEVENTH WEEK—FRIDAY.

ESCULENT ROOTS.—THE POTATO.

THERE is a great variety of roots and tubers, fit for the use of man and domestic animals, several of which are extensively cultivated, such as turnips, onions, carrots, parsnips, and beets. The most remarkable, however, and useful of them all, is the potato, to which, on this branch of our subject, I shall at present confine my attention.

The same mystery which hangs over the native place of most of the other plants, made use of by man as objects of cultivation, long attached also to the potato; but it appears now to be satisfactorily proved, that it is indigenous in the west coast of South America. In Chili and Peru it is found growing wild among the rocks, in remote places, where it is not probable that the seed could have been carried by the hand of man; and what seems to confirm the idea that it is there in its uncultivated state, is, that the flowers are always pure white, without any of those diversities of colour, which, in conformity to a well-known law of Nature, exist in the cultivated varieties.*

The potato plant seems first to have been introduced into Britain by Sir Walter Raleigh, in the reign of Queen Elizabeth; but, for more than a century, its progress was exceed-

* Account by Mr. Cruickshank, published in Dr. Hooker's 'Botanical Miscellany,' and quoted in the 'Journal of the Royal Institution,' for December, 1831.

ingly confined, owing probably to erroneous modes of cultivation, and to an improper manner of preparing it for food. In the reign of James I., this root was considered a great rarity, and sold so dear as two shillings per pound; and even as late as the beginning of last century it seems not to have entered into the list of agricultural produce. Bradley, who wrote about the year 1720, and who treated expressly of new improvements in horticulture, says of potatoes, 'They are of less note than horse-radish, radish, scorzonera, beets, and skerrit; but as they are not without their admirers, I will not pass them by in silence.'

The district of England, where the potato was first generally cultivated, seems to have been Lancashire; and, about the same time, it was introduced to general use in Scotland. In 1728, a day-labourer of the name of Prentice, living near Kilsyth, in Stirlingshire, successfully raised a crop of potatoes, on a little plot of ground attached to his cottage, and was fortunate enough to call the attention of his neighbours to the value of this hitherto neglected vegetable. By the annual sale of his produce, he soon realized what was to him a fortune, the sum of £200; and, meanwhile, the public attention being called to the plant, it gradually made its way. It was not, however, till after the year 1743, which was remarkable as a season of scarcity, that it came to be generally cultivated in Scotland as a regular branch of field husbandry. I very well remember a near relative of mine mentioning an anecdote, which showed that, so late as the year 1755, or 1756, the potato was still little known in Wigtonshire.*

In England, with the exception of Lancashire, the progress of this esculent into general cultivation was still slower. It was known in Yorkshire only as a garden plant, down to 1760; and, in Somersetshire, we must date its introduction,

* This incident was, that a lady had brought some potatoes in her pocket to church on Sunday, to present to a friend, as a rarity; but the string of her pocket breaking as she was in the act of going out on the dismissal of the congregation, she lost her burden in the passage, which created considerable amusement.

as an article of farm produce, at least ten years later. After this period, however, the value of the potato came to be very generally appreciated; and, in the year 1796, in the county of Essex alone, no fewer than 1700 acres were planted with this root, for the supply of the London Market.

Potatoes seem to have found their way into the Continent of Europe, at a considerably later period than into England; but they came more rapidly into common use, and we may date their general cultivation there from about the middle of last century.

This root, when first introduced as an article of husbandry, was acknowledged to possess more vigorous powers of reproduction than almost any other vegetable. In the potato itself are comprised the germs of numerous plants, which are situated in indentations called eyes; and the usual mode of propagating the plant has been by cutting the tuber into several sections, or sets, each containing one or more eyes. In this way good varieties are extended and preserved when once obtained.

The proper seed, however, is contained in the apple, a large green berry, which succeeds the flower. In this apple are found numerous white seeds, which, when sown, produce, like similar seeds, numerous varieties of the plant;* but the tubers obtained from the seeds are at first very few and small, and

* The Rohan potato, a variety raised on the Continent a few years ago from the seed, is remarkable for the size of its stalks, and its prolific powers. Prince Charles de Rohan, from whom it takes its name, writing of it from Geneva, in 1834, states, that the stalks reach six or seven feet in height, and require to be supported on transverse stakes; and that the tubers sometimes increase to such enormous size, that a single potato will weigh more than 13lbs; and, as to the quantity of produce, he mentions the following example:—'The attorney of the Abbey of Auterive, Canton of Fribourg, to whom I had given two tubers, two years ago, and who, delighted with his first harvest, after having eaten, and given some to his friends, planted the rest, obtained last autumn, *six double-horse loads, and eight scuttle-fulls.*' Le Cultivateur, Journal de Progress Agricolis, January 1835, quoted in the Journal of Agriculture, vol. vi. p. 145. The Author has cultivated the Rohan potato for the last two years, but he doubts if, in this climate, it will prove profitable for general cultivation.

it is not till the third year that these tubers come into full bearing, a circumstance which renders it unprofitable to the farmer to propagate the potato in this way.

It appears, however, from experience, that when potatoes are raised in the usual way, they gradually lose their vegetative energy, and become liable to diseases, and injurious influences, which, in their more vigorous state, they were able to resist. A tendency in the plant to degenerate, under the present mode of culture, has long been observed, and some farmers have been careful to renew it at intervals, by having recourse to propagation from the seed. But this useful practice has not been so generally attended to as it ought to have been; and, at the present time (1837), in consequence of this neglect, much distress is occasioned among the lower classes, in various districts, by the failure of the crops. The history of the propagating power of the tuber seems to be as follows:—At the third reproduction from a tuber, produced by a seed, the reproductive power, as has already been stated, is in full activity. Then the produce is greatest; but the potato being, at this stage, in general watery, and what is called waxy, is not esteemed very palatable for food. In a few years, however, by constantly reproducing from the tuber, the potatoes become less productive, but more dry and mealy. This progress goes on, year after year, the roots always improving in quality, but diminishing in quantity, till, at length, it should seem that the vigour of the living principle, by this mode of treatment, wears out, and the plant first becomes subject to disease, and alive to all unfavourable influences of soil and weather, and finally ceases to reproduce.

This subject has not hitherto been attended to by scientific, or even practical men, as it deserves. A crisis in the history of this valuable esculent seems, however, at last to have arrived, which must force the subject on public observation. The *curl*, a well-known disease, first alarmed cultivators. It began in Lancashire, where the potato was early cultivated, and soon spread over all the richest districts of the country. This seems to have been the earliest indication of decay in

the reproductive powers, and the precursor of that more general failure with which the community is threatened. What would be the consequence of the extermination of a crop on which has depended so much of the comfort of the poor, and to the introduction of which so much of the rapid increase of our population during the last century may be traced, it is dreadful to contemplate.

The whole subject, indeed, connected with the history of the potato plant, is full of varied interest. The religious mind, especially, will find cause for deep reflection on the ways of Him, whose providence acts always with such consummate wisdom, but frequently so mysteriously. By the discovery of this additional means of aliment, so salubrious, so plentiful, and so cheaply propagated, at a time when manufactures and the arts were, from other causes, in such rapid progress, it seems to have been the intention of Providence that society should receive an additional impulse, and that the population, constantly pressing against the means of subsistence, should obtain a temporary relief. But this, it is obvious, could only be available to a certain point; and, like every other improvement in the quantity and quality of food, has a tendency, by increasing the stimulus of human reproduction, to defeat itself. Whether or not the check, which appears at present to be in progress, shall be arrested by the application of human skill, or in what way it may operate, in promoting the moral welfare of civilized society, it is impossible to predict. But it cannot be doubted, that, like every other appointment of the Supreme Ruler, it will terminate in some important and useful result. It is the high privilege of the Christian to be assured that evil as well as good are in the hands of Him who 'doth all things well.'

ELEVENTH WEEK—SATURDAY.

VEGETABLE SUBSTANCES USED FOR WEAVING.—THE FLAX-PLANT.

VEGETABLES for food are of primary importance, but there are other uses to which various kinds of plants have been applied, and for which the Creator seems to have intended them. Among these the plants employed as materials for the production of woven fabrics, and twisted cords, deserve the first mention.

Flax is the vegetable which appears to have earliest attracted the attention of mankind, for the useful qualities of its fibres. We learn from the sacred record, that even so far back as the time of Joseph, men had exerted their ingenuity in the manufacture of this substance into cloth. The first mark of favour to that remarkable man, by the Egyptian king, was, among other things, to array him in vestures of fine linen. After this period, linen is constantly and familiarly mentioned in the Israelitish history, the fineness of the fabric being frequently alluded to. If it be doubted whether or not the flax which we now cultivate was the substance employed in this manufacture, all reasonable ground of doubt will be removed, by the accounts given of the linen cloths found in the unwrapping of Egyptian mummies of the highest antiquity. What is particularly worthy of remark is the fineness of the manufacture of these ancient cloths, indicating, what indeed we might have expected from the Scriptural notices, though otherwise scarcely to have been looked for, that, in this period of remote antiquity, the Egyptians, and perhaps some other nations, had advanced to a high degree of perfection in that art. Captains Irby and Mangles, speaking of the cloth found wrapped round the bodies of some mummies taken from pits at Gournou, on the site of ancient Thebes, say, 'Some of this linen is of a texture remarkably fine, far surpassing what is made in Egypt at this day, and proving that their ancient

manufactures must have arrived at a great degree of excellence.' If we were to suppose that Joseph's vestments bore any approach to these fabrics, it would be curious to speculate on a state of society which could so soon demand and reward the exercise of such ingenuity, while the other inhabitants of the world were little advanced beyond the simplicity of wandering shepherd tribes. At all events, the use of flax, as an article of manufacture, in so early a stage in the history of the world, is a fact of importance.

The hardy nature of the flax plant is a beneficent provision of Providence, which we must not omit to mention. 'There is scarcely any plant,' says the writer whom I at present chiefly follow, 'which is found to be so little affected by difference of soil and climate as the flax plant; and, accordingly, one species, with all its characteristics unaltered, flourishes in the cold as well as the temperate regions of Europe, in North and South America, in Africa, and in Asia.' 'This plant will grow on almost any land, but it impoverishes the soil, and therefore it is deemed prudent to sow it on rich rank ground, and never two years consecutively on the same spot.'

The common flax is an annual plant, which shoots forth in slender upright stalks, about the thickness of a crow-quill. The stalks are hollow pipes, surrounded by a fibrous bark or rind, the filaments of which, divested of all extraneous matter, and carefully prepared, are the material of cambric, linen, and other similar manufactures. The leaves placed alternately on the stem, are long, narrow, and of a greyish colour. When the plant has attained the height of about two and a half or three feet, the stem then divides itself into slender foot stalks, which are terminated by small blue indented flowers. These produce large globular seed-vessels, divided within into two cells, each containing a bright slippery elongated seed.

Although flax is easy of growth, its quality depends very much on fitness of soil and situation. Low grounds, and those which have received deposits left by the occasional overflowing of rivers, or where water is found not far from the surface, are deemed the most favourable situations for its cul-

ture. It is attributed to this last circumstance, that Zealand produces the finest flax grown in Holland. The alluvial soil of Egypt may, in like manner, account for the early and successful cultivation of the plant in that country. In the Crimea, too, and in the Russian territories near the Black Sea, on the rivers Dniester, Bog, Don, Dnieper, and in Kirban, where the soil is at once moist and rich, the flax is of a peculiarly excellent quality.

Preparatory to the cultivation of this plant, it is not necesary that the ground should be very deeply furrowed by the plough; but it should be reduced to a fine friable mould by the repeated use of the harrow. Two or three bushels of seed are required for each acre of ground, if scattered broadcast; but half the quantity will yield the same produce, if sown in drills. When flax is raised to be manufactured into cambric and fine lawns, double the quantity of seed is sown on the same space of ground,—the plants, growing nearer to each other, have a greater tendency to shoot up in long slender stalks; and as the same number of fibres are usually found in each plant, these will, of course, be finer in proportion as the stalks are slender.

The seed is usually sown in March and April. The plant blooms in the end of June, or beginning or middle of July, and is considered ripe, and fit for pulling, towards the latter end of August. It has been found by experience, that the seeds of flax, like those of most other plants, may be pulled without injury, and even with advantage, before they are quite ripe, provided they are not detached until dry, from the parent plant; and it has also been found, that the period which precedes maturity, when the stalks begin to turn yellow, but before the leaves fall, is the most advantageous time of removing them from the soil, for giving softness and strength to the fibre. The Dutch avail themselves of these facts, while they are either unknown or neglected, especially as relates to the seed, by their less intelligent and careful neighbours. After pulling the plants, they stack them. The seed, by this means, becomes ripe, while the fibres are collected at the most

favourable period of their growth, and both the valuable products of the plants are secured in their perfection.

It would be inconsistent with our plan to detail the various laborious processes by which the flax is prepared for manufacture; and I shall only add, that not only is the fibre of this valuable plant converted into cloth, but from its seed an oil is extracted, which is extensively used in the arts.

In this short account, the reader must have seen occasion, in various particulars, to admire the Creative intelligence and bounty, which has made a plant of such general utility so extensively available for cultivation. In the constitution of the flax plant, as of many others, two intentions of the Creator are particularly conspicuous,—the one is to bestow upon man a useful gift, and the other to call forth his inventive faculties, to stimulate his activity, and to reward his industry and skill.

TWELFTH WEEK—SUNDAY.

TRUE SCIENCE, THE HANDMAID OF RELIGION.

There are few mistakes less reasonable than that which leads believers to entertain a jealousy of the investigations of science, as if there were a risk that our holy faith might be undermined by the progress of philosophical discovery. Science, properly so called, is nothing else than the knowledge of truths. Scripture, rightly interpreted, is emphatically the word of truth; and, though the subjects treated of by each, may have no immediate relation to one another, still it is impossible that there should be any contradiction between them. Truth cannot be opposed to truth.

But it will be said that this reasoning is refuted by facts, since those who have entered most deeply into scientific investigations have been often tainted with infidelity. This, how-

ever, is an assertion to which we cannot subscribe. It is true that much which has been falsely termed philosophy, has been from time to time quoted in opposition to the authenticity of the Bible, and that many, who have been dignified with the title of scientific men, have lent to the same cause the credit of their names. But there was nothing approaching to infallibility in either; and, I need not say, that the invariable result of more patient research, and more mature consideration, has been to establish the Bible's divine authority more firmly and satisfactorily than ever.

The particular subjects upon which philosophy has been employed by infidel writers, to aid them in their attacks upon Scripture, are those upon which the sacred volume was never intended to afford us any specific information; such subjects, for example, as the structure of the earth and the planetary system. It has already been shown, that to look for a formal treatise on cosmogony or astronomy in a book intended to reveal the method of man's recovery to the favour of God, and to instruct him in his duties, would be altogether to mistake the nature and character of such a publication. Scripture, if it enter on these subjects at all, speaks not in the language of scientific truth, because it is not addressing philosophers, as such, but in the simple language of plain men, for whose use it was intended. And yet, in the first chapter of Genesis, and in various incidental notices scattered through its pages, we find enough said in this spirit, at once to bring Revelation to the test of *genuine science*, and to afford short-sighted, presumptuous, and shallow smatterers in 'science falsely so called,' not the shadow of an apology for subjecting it to their scepticism. This test has been applied,—this criticism has been exercised,—by persons of every variety of intellect, and temper, and disposition:—And what has been the result? It is instructive to glance at the history of this controversy from the first dawn of philosophy after the night of the dark ages. A gloomy superstition, only relieved here and there by the genuine piety of such men as Thomas A Kempis, brooded over Europe; and when a spirit of inquiry was

first evoked from the moral darkness of the world, the jealousy of religionists, who, in the excess of their bigotry, had been at no pains to inquire into the foundations of their faith, and knew not how strong are the pillars of the Christian temple, induced them to wage, against those who manifested any disposition to question the truth of ancient opinions, a war of unrelenting persecution. Although we may deeply lament that the name of religion should ever have been prostituted to such a service, and although we may well sympathize with the sufferings of such martyrs as Galileo, we have reason to rejoice that the spirit of investigation was not thus to be quenched.

It proceeded in its luminous way, till it gained the positio and the power which it deserved; and, in place of being looked on as the foe, became the handmaid and the friend of the faith of Jesus. During this process, however, if professed Christians were blameable for their folly in thus adhering to a system, and defending it with the weapons of a carnal policy, when they had not the moral courage to examine its authority, the disposition of many who assumed the air and the garb of philosophical inquirers, was as little to be admired. Pleased with their own fancied discoveries, or led away by an enthusiastic admiration of those of others, or perhaps, in many cases, glad of an excuse for casting off the restraints of religion, such individuals, during a long series of ages, were perpetually to be found thrusting forward the crudest speculations, which they dignified with the name of truths, and to which they demanded the unqualified assent of all who pretended to the character of scientific men. These notions often became fashionable for a season; and then Scripture must be brought to answer at their bar, and must be condemned or approved, only as it should be found to agree with this, for the time, infallible test of truth. Thus were religion and infant philosophy unnecessarily brought into collision, and the indubitable declarations of the former made to hold a subordinate place to the uncertain indications of the latter. Hence, till toward the close of the last century, nothing was more com-

mon than the malignant insinuations of an infidel spirit, or the open attacks of scepticism. These efforts were chiefly favoured by the imperfection of the sciences. A portion of the book of Nature had been opened, but so small a portion as to leave the full bearings of every subject to be guessed at, rather than known; while the vanity and recklessness of half-taught minds, attributed to their pretended discoveries all the authority of facts, and induced their adherents to exalt them infinitely above any opposite opinions, however long established,—nay, even to prefer them to the Bible itself.

Of the ease with which the human mind, when once disposed to give an undue preference to any fondly cherished views, may be induced to resist the most palpable demonstration of an opposite tendency, we have a remarkable example in the history of the blessed Redeemer. What philosophy was to the literati of the last century, the investigation of the Old Testament Scriptures appears to have been to the Rabbis and Scribes of our Saviour's era. Now, we are told,* that, shortly after the commencement of his ministry, Jesus went up to Jerusalem, and when he had given public testimony there to his divine character, in two ways,—first by the performance of a miracle, and then by the striking character of his preaching,—presently a discussion arose among the citizens, as to the weight of his pretensions. Some inclined to a belief, that so extraordinary a man could be no other than the Messiah; others attributed his powers to the influence of Satan; but there was a third class, who, in the very spirit of modern scepticism, produced their pretended knowledge of the law, as the infallible datum upon which the question was to be decided. 'We know whence this man is; but when Christ cometh, no man knoweth whence he is.' This argument, plausible as it might appear, had no good foundation. Its premises were entirely defective. No passage in the Old Testament makes any assertion such as that which is here pretended. Isaiah, indeed, asks the question, 'Who shall declare his generation?' and the Rabbis,

* John vii.

founding upon this, had formed the opinion, that the place of Christ's birth, and that of his parentage, should be a mystery; or perhaps they deduced this notion from the typical history of Melchizedek. But, from whatever source derived, and however plausible it might appear to them, ignorance was its author, and that very book on which they professed to found their opinion, in various passages, contradicted it. For what can be plainer than the language of Isaiah on this very subject,—'There shall come forth a Rod out of the stem of Jesse, and a Branch shall grow out of his roots?' or what more distinct than the words of Micah, 'Thou Bethlehem Ephratah, though thou be little among the thousands of Judah, yet out of thee shall he come forth unto me that is to be Ruler in Israel, whose goings forth have been from of old, from everlasting?' If, instead of holding to their unsupported theories, they had only been at the pains to turn their attention to such passages as these, and, not content with a part, had diligently compared the whole of the ancient Scriptures with the history of Jesus, they could not have resisted the assurance that verily he was the Son of God, the Messiah who was to come.

The application of this illustration may safely be left to my readers. Let us rejoice that the progress of genuine knowledge has greatly altered the relations that subsist between philosophy and religion. The frequent demonstration of the liability of the most learned to err, has taught wholesome lessons of modesty and caution. The more deeply Nature has been investigated, the closer the analogy has been manifested which exists between the work of creation and the work of grace revealed in the word of God. Proofs corroborative of the authenticity of the Bible, have been gathered from those very sources which formerly were applied to by the sceptic for his sharpest weapons; and at this moment (such is the security with which Christianity may regard the progress of knowledge), there does not exist in our own country, nor, so far as I am aware, in any other, one philosopher of eminence who has ventured to confront Christianity and philosophy as manifestly contradictory. May we not venture to hope that,

in a very short time, the weak darts of minor spirits, which from time to time are still permitted to assail our bulwarks, will be also quenched, and the glorious Gospel, set free from all the oppositions of science, falsely so called, shall walk hand in hand over the earth with a philosophy always growing in humility, because every day becoming more genuine.

G. J. C. D.

TWELFTH WEEK—MONDAY.

VEGETABLE SUBSTANCES USED FOR WEAVING.—THE COTTON-PLANT.

The cotton-plant, another vegetable substance, extensively used in manufactures, differs materially from that already described, in its properties, appearance, and habits. Instead of being generally diffused over temperate climates, it belongs more properly to the torrid zone, and the regions bordering on it; and, instead of being chiefly confined to one species, as to its peculiar and useful qualities, its varieties seem scarcely to have any limit, extending from an herb* of from eighteen to twenty inches in height, to a tree† far surpassing our largest oaks in elegance and magnitude. In one species it is annual, in another perennial. The nature of its fibre, the shape of its leaves, its flowers, and its fruit, all form points of contrast. It is in the pod of all the species that the substance is situated which forms this valuable article of manufacture. In one kind this pod contains only ten or twelve seeds; in another as many as thirty; while in all there is a marked difference in colour, shape, and size. In the quality and colour of the cotton itself, there is considerable variety. Some plants produce cotton of a dazzling whiteness, others of a yellowish brown, or a pale red colour, with many intermediate shades, —from that which serves as the material for the Chinese

* Gossypium herbaceum, or common herbaceous cotton-plant.

† Bombax ceiba, or African silk cotton-tree.

nankeen, to that which in the West Indies is known by the name of Siam, and is so noted for the snowy brilliancy of its hue, as well as the fineness of its long elastic fibres. Lastly, some kinds are much more productive than others, one yielding its downy harvest twice in the year, another only once,—one giving an abundant, another a scanty, return.

All this gives exercise to the ingenuity and intelligence of the cultivator. To him it becomes a matter of much interest to be made acquainted with all the distinctive varieties, some being so much more valuable than others. For want of this knowledge, so little regard is frequently paid to the selection of the seed and the improvement of the stock, that the careful planter, on first commencing his plantation, has to contend with many difficulties, and can only hope to succeed at the cost of much labour, and numerous disappointments; but then his industry promises, in the end, to produce an ample reward.

The cotton-plant will grow within a certain range of climate, in most situations and soils, and is cultivated with very little trouble or expense. According to Humboldt, the larger species, which attain to the magnitude of trees, require a mean annual temperature of 68° Fahrenheit; the shrubby kind may be cultivated with success under a mean temperature of 60° or 64°, and may be propagated as far as latitude 40°. This plant is indeed cultivated in the neighbourhood of Astracan, the latitude of which is 46°. Some species flourish best in the neighbourhood of the sea; others again require the interior. The Pernambuco cotton, which is the finest in Brazil, is of the latter kind; and the planters find, that in proportion as they recede from the coast, the quality of the cotton is improved; they are, in consequence, every year penetrating farther into the interior, and they always obtain a ready market for their produce, as the dealers follow their footsteps, and settle where they settle.*

When the season has been favourable, the cotton is gen-

* Kosler's Brazil.—Library of Entertaining Knowledge, on Vegetable Substances, p. 41.

erally fit for pulling about seven or eight months after it has been sown. This period is well indicated by the spontaneous bursting of the capsule or seed-pod. The plantations, at this time, present a very pleasing appearance, the glossy dark green leaves, finely contrasting with the white globular forms profusely scattered over the plant. In the East the produce is gathered by taking off the whole of the pod. In other parts, and this is the more general practice, the seeds and cotton only, are taken away, leaving the empty husks. The latter method is the most advantageous, though the most tedious; for when the outer part is removed, it breaks among the cotton, and it cannot be freed from it without much time and difficulty. Whichever method is pursued, the work is always performed in the morning, before sunrise, as soon as possible after the cotton displays itself, because long exposure to the sun injures its colour, by giving it a yellow tinge.

The celebrated Sir Richard Arkwright, then a poor barber, gave to British manufactures an extraordinary stimulus, by the invention of spinning machinery—one of the most astonishing and successful efforts of mechanical ingenuity. Since that period, the annual increase of our manufactures, and the consequent consumption of cotton, has been rapidly progressive. The present average value of cotton goods exported from Great Britain, amounts to the enormous sum of from thirteen to fifteen millions sterling for piece goods, and from three to four millions for yarn and twist.

The processes of spinning and weaving, as conducted by machinery, are truly astonishing; but I must not at present stop to describe them. The following fact, however, which I extract from the Library of Entertaining Knowledge, will serve to exemplify the celerity with which manufacturing operations are now conducted in this country. The proprietor of a cotton manufactory in Manchester, having recently received an order for the shipment of some goods of a particular description, purchased ten bales of cotton of suitable quality, in Liverpool. On their arrival in Manchester, they

were received into the highest floor of his works, and thence, proceeding regularly downwards, underwent all the intermediate processes of carding, spinning, and weaving, until, in ten days from their reception, the finished goods into which they were converted, were packed in bales, and were proceeding again to Liverpool for shipment.*

When, in 1787, spinning machinery was first erected, one pound of Demerara cotton could be spun into yarn one hundred and sixty miles in length.† Since that period, great improvements have been made in this kind of machinery; and yarn is now spun having a still greater degree of fineness.

There cannot, perhaps, be a more remarkable proof of the effect which the various providential arrangements of the material world produce, in stimulating the mental qualities, than in the invention of the machinery which possesses these amazing powers. The invention and perfecting of the steam-engine, with its tremendous forces, had only a little while preceded it; and this, too, received its stimulus from the wants of civilized man in another department. The mechanical genius of Arkwright took fire at this effort of a kindred mind; and, minutely observing the laborious, and sometimes imperfect processes, by which the produce of the cotton-plant was fitted to supply the necessities and comforts of men, he formed the apparently Utopian scheme, of applying this newly discovered force to the improvement and acceleration of these processes. The difficulties with which, under the most favourable circumstances, a poor and unfriended workman had to contend in this most arduous attempt, may be more easily supposed than described; and these difficulties seem to have been tenfold increased by domestic jars and want, consequent on the neglect of his proper employment. The time, however, was come, when the progress of society demanded, as it were, a genius adequate to the task. Arkwright persevered; and, by the dint of an energy of mind and a power of invention, with which few mortals have been favoured, produced a system of machinery, which, for the ingenuity of its contri-

* Article, Vegetable Substances, p. 49. † Macpherson.

vances, and the extent of its complicated arrangements, forms one of the noblest monuments to genius ever erected by human resources. And, what constituted his highest reward, he had the satisfaction to think, that by this one happy invention, he had bestowed a gift on his country, which was to be the means, in the hand of Providence, of averting, or, at least, indefinitely protracting the period of a national bankruptcy, on the verge of which Britain was labouring, of largely advancing its prosperity, and of giving vigour and permanency to its various powers.*

TWELFTH WEEK—TUESDAY.

VEGETABLE SUBSTANCES USED FOR CORDAGE.—HEMP.

The vast importance of commerce to the advancement of society, has rendered every thing which may promote its welfare a matter of research, especially in modern times. Among such objects, materials, which may contribute to safety or commodious use in shipping, hold a prominent place. In the early history of navigation, thongs of leather were usually, and, indeed, almost universally, employed for the purpose of naval cordage; and it was not till civilization had made considerable advances, that vegetable substances were generally substituted. There are several kinds of these substances, however, which have been found admirably adapted for this purpose; and, among these, hemp is that most commonly used.

This plant seems to be indigenous in Europe. We have, at least, proof, that it has grown, and been employed, in this quarter of the world, for between 2000 and 3000 years. Herodotus, the father of Grecian history, says, 'Hemp grows in the country of the Scythians, which, except in the thickness

* In 1762, Hume had predicted a national bankruptcy, should the national debt ever amount to a hundred millions. He founded his anticipations on reasoning, which only proved to be unsound, because he did not take into account the inventive genius of a Watt and an Arkwright.

and height of the stalk, very much resembles flax; in the qualities mentioned, however, the hemp is much superior. It grows in a natural state, and is also cultivated. The Thracians make clothing of it, very like linen cloth; nor could any person, without being very well acquainted with the substance, say whether this clothing is made of hemp or flax. A person who has never before seen hempen cloth, would certainly suppose, that this, of which I am speaking, is made of flax.'* This quotation seems to prove the coarseness of the cloth manufactured in the time of Herodotus. There could have been no difficulty in distinguishing between the cloth made from flax and from hemp, had the linen of those days borne any resemblance to that of modern times.

Hemp† is an annual plant, usually rising to the height of five or six feet. In some situations, it is, however, capable of attaining to a much larger growth. Du Hamel relates, that in some parts of Alsace, hemp plants are found, which reach twelve feet in height, and are more than three inches in diameter at the bottom of the stalk, having such deep roots that the strongest man is not able, unassisted, to pull them out of the ground; and in a new drained marsh, near the Lago di Patria, in the Neapolitan dominions, hemp attained, in 1826, nearly the same dimensions. The fibres of the bark in this plant, like that of flax, comprise the part used in manufacture.

The stalk is channelled and hollow in the inside, containing a white soft medullary substance, enclosed in a very tender tube, commonly called the reed, or, technically, the *boon* of the hemp. It is covered with a green bark, rough and hairy, which is formed of numerous fibres, extending the whole length of the stem. These are not reticulated, but placed parallel to each other, and united by means of the

* Herodotus, book iv. p. 74 The Scythians of Herodotus lived in Europe, north of the Danube, and bordering on the Black Sea.

† *Cannabis sativa.* The word canvas, which is the name for hempen-cloth, is an obvious corruption of this Latin term. The Italians, making but little change, call it '*canape.*'

cellular texture. A microscopic view of these fibres discloses, that each single fibre is itself a bundle of fibrils, of extreme fineness. They are twisted spirally, and, after maceration, may be stretched out to a considerable length. This description may serve to show how well adapted such fibres are for giving strength and pliancy to the articles manufactured from them.

The leaves grow on opposite footstalks, by pairs; they are divided, as far as the foot-stalks, into four, five, or a greater number of narrow segments, pointed, or deeply indented in the margin. The flowers and fruit grow upon separate plants, —the former the male, and the latter the female plant. In general, the male hemp is more slender and delicate than the female. The stem divides itself, at the extremity, into several branches, terminating in thin pointed spikes, while the female plant is surmounted by tufts of leaves of a considerable size. The flowers of the former grow near the summit of the stem, which generally rises about half a foot higher than that of the female,—a creative contrivance, by which the farina or dust that conveys fertility to the seed is readily shed on the latter. The fruit grows in great abundance on the stem of the female plant. This seed is not preceded by any flower; a membranaceous hairy calyx, terminating in long points, encloses the pistil, the base of which becomes the seed. The male hemp is of quicker growth than the female, and sooner arrives at maturity; either kind is produced indiscriminately from the seeds sown, and the difference cannot be known until the plants are somewhat advanced.

Most soils may be made fit, by good manuring, for the cultivation of hemp; but rich, moist earth, is considered the most favourable to its growth. A poor land will yield but a scanty crop; the quality, however, will be proportionally finer. Cultivators are therefore regulated in their choice of soil by the description of hemp they wish to raise. Sir Joseph Banks remarks, on this subject, that 'coarse hemp, such as is required for the manufacture of cables, hawsers, and other heavy rigging, requires every where an abundance of manure, and land of the richest quality.'

Hemp possesses other properties besides the highly useful one of being gifted with fibres capable of conversion into cordage and articles of clothing. Pliny speaks of the root, juice, and other parts of this plant, as possessing wonderful medicinal virtues; and it would seem, that for such qualities it was held, in those days, in higher esteem than for the qualities which now occasion its cultivation.* It is also remarkable for its property of destroying weeds. These are known not to vegetate in a hemp field, whether it be that some peculiar poison resides in its roots, or that it draws off all the nourishment that would otherwise contribute to the growth of noxious plants. This well-known fact is sometimes taken advantage of by agriculturists, to cleanse the land from troublesome intruders. In the swamp near the Lago di Patria, already mentioned, the greatest difficulty, after it was drained, was to get rid of reeds, that rose 'higher than a man on horseback.' The sowing of hemp was found to be by far the most efficacious method.

Russia is the country in which the hemp plant is most successfully cultivated. In 1799, about 600,000 cwt.† were exported in British ships from St. Petersburg alone. This was a period of war, when the consumption of that article was, of course, much increased, as will be readily seem, when it is known that the sails and cordage of a first-rate man-of-war require no less than 180,000 lbs. for their construction. The present importation from that quarter (1837) somewhat exceeds the amount of 1799.

* Thumberg, on a journey from the Cape of Good Hope into the interior of Africa, found the Hottentots cultivating hemp. 'This is a plant,' says he, 'universally used in this country, though for a purpose very different from that to which it is applied by the industrious Europeans. The Hottentot loves nothing so well as tobacco, and with no other thing can he be so easily enticed into servitude; but for smoking he finds tobacco not sufficiently strong, and therefore mixes it with hemp chopped very fine.'

† Assuming that it requires five acres of ground to produce a ton of hemp, the whole space of ground requisite for raising the above quantity, would be 155,670 acres.

TWELFTH WEEK—WEDNESDAY.

VEGETABLE SUBSTANCES USED FOR PAPER.

THE invaluable art of writing, by which thought is treasured up in silent repositories, and transmitted, from generation to generation, and the accumulated wisdom of ages is preserved and increased, has given rise to a new use of vegetable substances, which may well be considered as only second to that which converts them into articles of food.

When writing was first invented, the hides of animals, the barks of trees, the broad, strong, and lasting leaves of the palm, or a plain surface of stone or metal, were most probably used. They were succeeded or accompanied, in some countries, by tablets of wood coated with wax, on which the writer engraved his characters with a style, or some other implement.

The first manufactured paper we hear of, was that made from the papyrus,* a species of reed growing abundantly on the banks and in the waters of the Nile ; and this substance continued to be partially employed till about the middle of the seventh century, when its use was, for a time, entirely superseded, in Europe, by parchment,—an Eastern invention.

The papyrus is an aquatic plant ; its roots are large and tortuous ; its stem is triangular, gradually tapering as it shoots up gracefully to the height of fifteen or twenty feet, where it is very slender, and is surmounted by a fibrous tuft of fine filaments, which are again subdivided into others, bearing small seedy flowerets, the whole of the umbel forming a beautiful flowing plume.

Paper was made from the inner bark of the stem of the papyrus, which was divided into thin plates or pellicles, each of them as large as the plant would admit. These plates, after trimming, were laid close together so as to touch, on a smooth table, and then other plates were laid crosswise, when

* Hence the word *paper*.

the whole was watered and pressed; by which means, owing to the glutinous substance contained in the plant, they adhered, forming a sheet of any size the manufacturer might require, and, being dried in the sun, they were fit for use.

Some of these sheets were of great length, and they were always used in the form of a roll. The indefatigable traveller, Belzoni, had a papyrus in his possession, which was twenty-three feet long, by one and a half broad. 'This last,' says Dr. Richardson, 'is the finest and the largest I ever saw.'* The quantities of this manufacture used by the Egyptians, exclusive of what was exported, must have been immense, judging by the remains found in mummy-pits, which have been transmitted to the present day; nor could its exportation have been inconsiderable, as may be believed from the fact, that there are now in the museum of Naples nearly eighteen hundred MSS., written on this kind of paper, which were all dug out of the lava that entombed the ancient Herculaneum, although but a very small portion of that city has as yet been excavated.

The use of parchment, which superseded that of the papyrus, as already mentioned, gave way, in Europe, to that of paper made from cotton, about the beginning of the tenth century. This highly useful substitute appears to have been introduced from Asia; and its history has been thus traced.—The Chinese possessed the art of paper-making at a very early period. By that people it was manufactured chiefly from the young shoots of the bamboo. From them their neighbours, the Tartars, received it, substituting cotton for their material; and these transmitted it, about the beginning of the eighth century, to the Arabs, from whom it was derived by the inhabitants of Europe, either through the commercial intercourse carried on by the Venetians with Syria, or, as some have supposed, by means of the irruption of the Saracens into Spain, who were Arabs under another name.

England was among the last of the European countries into which paper was introduced,—an event which did not

* Travels in the Mediterranean.

take place till so late as the beginning of the fourteenth century. It is only 140 years since writing-paper became an article of home manufacture in this island, though Britain has the merit of bringing it to a higher degree of perfection than any other country. The quantity manufactured in England alone, in 1832, was 53,949,572 lbs; in Scotland, 8,806,780; in Ireland, 2,179,303.

The substitution of linen for cotton, in the manufacture of paper, was a great improvement. The paper produced from the latter substance, indeed, was white, strong, and of a fine texture, but not so durable, nor so well adapted for writing as the paper now in use. The time when this change took place, is somewhat uncertain. In 1762, M. Mirman offered a reward for the discovery of the most ancient manuscript, written on paper made from linen rags; and the result to which his inquiries led him, was to fix the commencement of this manufacture between the years 1270 and 1302. There is, however, a small specimen, since discovered, and preserved in the Imperial Library of Vienna, which carries the date still further back. It is a deed written in the year 1243.—This modification of the art, as well as the art itself, seems to have been derived from Asia.

Various nations use different materials for the purposes of writing. The natives of Ceylon employ, for this purpose, the gigantic leaves of the mountain palm, called by them the talipot-tree, which are so durable, that they have for many ages resisted the ravages of time; the Japanese made an excellent paper from the bark of a species of mulberry-tree; the Tonquinese manufacture paper from silk, and from the rinds of different trees; the Persians use a mixture of cotton and silken rags, which, when made, they polish with a stone or shell; the aborigines of Mexico prepared a kind of material, for their simple hieroglyphics, from the pulpy part of the leaves of the same aloe, which yielded them a grateful beverage, and afforded them a strong cordage.

In the Transactions of the Society for the Encouragement of the Arts, &c., numerous experiments regarding the manu-

facture of paper are detailed; and their library contains a book, written in German, which exhibits between thirty and forty specimens of paper made from different materials. The author of this work was M. Schäffer, an enthusiast, who devoted his life to discoveries in this useful art. The bark of various trees, such as the willow, the beech, the aspin, the hawthorn, and especially the lime, have been successfully formed into paper. The wood, as well as the inner bark of the mulberry; the down of the catkins of the black poplar;* the tendrils of the vine; the stalk of the mugwort; the rind and ligneous part of the nettle; the stalk of the common thistle, as well as the down which envelopes its seed; the bark and stalk of briony; the leaves of the catstail; the slender stalks of the climbing *clematis;* the ligneous twigs of the branching broom; the fibrous stem of the upright lily; and the succulent stalks of the river-weed,—all were alike successfully brought into a pulpy consistence, capable of forming paper, by cohering in thin and smooth surfaces.

Substances yet more unpromising were made to yield to the persevering efforts of this ardent experimentalist. The moss of turf, trees, earth, and coral, as well as cabbage-stalks, wood-shavings, and saw-dust, were successfully manufactured; nay, even the rind of the potato, and the potato itself. This latter substance, indeed, proved a most excellent material, producing a paper extremely smooth and soft to the touch, while its tenacity approached nearer to parchment than any other vegetable substance thus employed, which caused M. Schäffer to esteem it as a valuable drawing-paper.

Perhaps the most interesting of the whole of these experiments, is that which is mentioned of the common fir-top, which is well known to be a hard woody cone, composed of overlapping scales. M. Schäffer's foreman had purchased a bird, whose natural sustenance is the fruit of the fir-tree. On watching the movements of this bird, when engaged in devouring its favourite food, it was observed diligently tearing

* The paper made from these catkins is said to be of very superior quality, being peculiarly soft and silky.

to pieces each scale of the cone, until at length the whole assumed the form of a ball of tow, in which state it was prepared for its food. It immediately struck the foreman, who seems to have imbibed part of his master's enthusiasm, that the fir-apple thus treated might be converted into paper. The hint was taken, and a paper was soon produced, strong and serviceable, and well fitted to be employed as wrapping paper.

In all these details, the reader can scarcely fail to be struck with the adaptations between the vegetable and rational creation, the former affording such interminable scope to the latter, for the exercise of ingenuity, and the reward of judicious labour.

TWELFTH WEEK—THURSDAY.

THE SACRAMENT OF THE SUPPER.

The chief duty I have assigned myself in writing the 'Sacred Philosophy of the Seasons,' is to draw from natural objects, as they unfold themselves in the progress of the revolving year, proofs of the being, perfections, and attributes of the unseen Creator. The importance and the satisfactory nature of the argument thus deducible, has been long appreciated; but still that argument is, and must necessarily be, defective; and we must look to a higher source when we seek for those assurances on which rest all our hopes of future felicity. It is on this very defect, indeed, that the necessity of a direct revelation from heaven is founded. If, in the book of nature, we could have read, and, from the ordinary operations of Providence, could have received, all that was necessary to salvation, there would have been no need of that other book which brings life and immortality to light; or of those miraculous transactions which raise our astonished view beyond the things that are seen and temporal; and we may well believe that, without such necessity, the ordinary course of things,

—the eternal laws of the universe,—would not have been disturbed by messengers from the silent world of spirits.

I have often felt this defect pressing upon me, and longed for more frequent and favourable opportunities of rising to still higher views of the character of the Eternal, and of the future destiny of the human race. Of such opportunities, indeed, I have availed myself in the Sunday papers, and I have sometimes also either found or made them at other times. When they have occurred, I trust my readers have felt, as I have felt myself, that they were as a place of refreshment and peculiar delight, in a journey itself full of beauty and enjoyment.

This period of the year furnishes us with one of these interesting resting-places, which I could not readily excuse myself were I to pass by. It was about the present season that the hopes of the Christian were confirmed and sealed, by the sufferings, death, and resurrection of the Son of God.* Let us, then, break in upon matters of unspeakably inferior importance, that we may attend to the particulars of these aston-

* The period of the Jewish Passover, during the celebration of which Christ was crucified, is not doubtful, because it was expressly fixed by the command of God, and the date is carefully recorded in the Book of Exodus. It was on the evening of the fourteenth day of the first month of the ecclesiastical year, called the month Nisan, and this month commenced in one or other of the three last weeks of the month of March, or the two first weeks of April, according as the period of the new moon was earlier or later; for the Israelites regulated their months by the changes of this luminary, beginning every new month at the new moon. This prevents the possibility of practically fixing down the date of the crucifixion to a precise day or week of the year; but, by attending to the time of new moon, the period may be ascertained with all the precision which appears necessary; though, even then, the looseness of the Jewish method of computing time, seems to preclude absolute accuracy. According to the most approved authorities, the day of the crucifixion must have occurred some time between the 20th March and the 23d April. Both Roman Catholics and Episcopalians, who observe this anniversary, have agreed to celebrate the day of the resurrection on the first Sunday after the first full moon that follows the 21st March, unless that full moon should happen on Sunday; in which latter case, the succeeding Sunday is chosen. The reason for this mode of calculation rests in the fact, that the Passover took place on the fourteenth day of the month, and therefore on the day of full moon.

ishing transactions, as they occurred in succession, during this and the two remaining days of the week, and were consummated on the first day of the following week.

It was upon that day of the week which corresponds to our Thursday, that Jesus, while partaking of the Passover, with his twelve apostles, instituted the holy ordinance of the Supper, in commemoration of his mysterious sufferings, which were to commence that very night in the garden of Gethsemane, and especially of his death on the cross, which was to be inflicted on the next day.

The appointment of this sacred rite, in itself so important, in its manner so beautifully simple, and, in the time chosen for its first celebration, so deeply affecting, was entirely in harmony with the character of Jesus, and with the pure and humble spirit of his religion. His tremendous sufferings lay at that moment open to his prophetic view, and were pressing heavily on his soul. But not with his own woes did he occupy his thoughts. His care was to provide consolation and encouragement to his disciples. 'Having loved his own,' as an apostle beautifully expresses it, 'he loved them to the end.' He resolved to leave them, under circumstances so affecting, a pledge of his enduring love, which, as a dying gift, might gratify their feelings, and, as a solemn religious rite, commemorate the blessings about to be procured for them by his death, while, in the act of commemoration, they might receive a sign and a seal of these blessings.

For such a pledge he sought not in any splendid or expensive ceremonial. He had recourse to the ordinary food, of which they were then partaking, and found, in bread and wine, the most expressive and the most appropriate of emblems. *Bread*, the staff of man's natural life, most aptly represented Christ, the staff of man's spiritual life: Bread *broken*, strikingly indicated the death of torture which the Saviour was to endure for his people: Bread *eaten*, was a fit type of the inward reception necessary to be given to the doctrine of the cross, before it can contribute to our spiritual nourishment. In the same manner *wine*, with its vivifying influences, beauti-

fully shadowed forth the blood of Christ, blood being the natural vehicle of life to the human body. Wine *poured out*, exhibited the shedding of his blood, that is, the sacrifice of his life for the remission of sin: Wine *tasted*, indicated the personal application of that blood of atonement, that is, its appropriation, by believers, each to himself,—so indispensably necessary to salvation.

Thus the action itself, united with the time and manner in which it was performed, was calculated to make the deepest and most salutary impression, not only on the apostles, with whom it was personally transacted, but on all the disciples of Jesus, to the latest generations, who should, from them or their successors, receive the hallowed rite.

And this impression it has actually produced. In all the severe trials which those holy men who sat with their Divine Master, at the feast of communion, had to endure in their future lives, the pledge of his love thus so condescendingly and affectingly given,—the memorial of his death, then so solemnly instituted,—formed a ground of unspeakable consolation, and a never-failing source of strength and enjoyment. It was at the table, where their beloved Saviour had himself personally presided, that the apostles renewed their communion with this best of friends; heard once more the gracious words which he uttered; were again enlightened, encouraged, and consoled by his presence; and saw him, with the eye of faith, as they had seen him with their bodily eyes, distributing to them those symbols of his expiatory sufferings and death, they were so soon to witness. How vividly and overpoweringly would the whole succeeding scene, at these moments, rise to their awakened view,—the agony in the garden, the insults of the judgment-hall, the torture of the cross;—and, along with these, his exhortations, his assurances, his words and looks of pity and unextinguishable love;—and, above all, that proof of affection, stronger than death, which he exhibited, when he bore the punishment due to their sins, 'in his own body, on the tree.'

Events so impressive, thus impressively recalled, could not

fail deeply and permanently to affect their minds. No wonder that, when animated by such a memorial, they endured persecution and contempt with patience; nay, when condemned to the scaffold or the stake, rejoiced that they were counted worthy to suffer in the service of a master endeared to them by so many ties.

Similar effects have been produced in the minds of communicants, from the days of the apostles to the present hour. Whatever, in the whole history of the church, has been lovely or of good report, received its origin or its encouragement in this solemn act of communion. The confessors, the martyrs, the reformers, who stood forward, in the midst of inveterate foes, to bear testimony to the truth as it is in Jesus, and whose names are in the churches as ornaments of religion, and benefactors of an ungrateful world; and not less, though in a more humble sphere, the innumerable company of private Christians, who walked through this vale of tears, looking to Jesus, and whose names, forgotten perhaps on earth, are written in the imperishable records of heaven,—these all renewed their vows, confirmed their faith, and cherished their graces at the table of him who loved them even to death. There, the Christian penitent has received comfort, the Christian pilgrim food and refreshment, the Christian soldier energy to contend against, and strength to overcome, all his enemies; and there will his disciples continue to receive spiritual nourishment and growth in grace 'until he come.'

TWELFTH WEEK—FRIDAY.

THE CRUCIFIXION.

The astonishing event predicted in ancient prophecy, frequently alluded to by Jesus in his intercourse with his disciples, and typically represented on the preceding evening in the Sacrament of the Supper, was now to be accomplished;—Christ, our Passover, was to be sacrificed for us. In the

agony of the garden, which quickly succeeded the institution of the Eucharist, the concluding scene of the Saviour's life may be said to have commenced. He was then subjected to a torture of soul which God alone could inflict, and the Son of God alone could endure. The bloody sweat, and the prayer for mitigation, are awfully expressive of the unspeakable intensity of the mysterious sufferings of that hour of the powers of darkness.

There were, indeed, crowded into a few short hours a complication of horrors, on the one hand, and manifestations of fortitude, of patience, and of Godlike love, on the other, which it is impossible to contemplate without amazement, and every one of which might well call forth a lengthened homily, on the blindness, ingratitude, and rebellion of man, and the boundless mercy and grace of the Redeemer. But I hasten to the last act of brutal ferocity with which the transactions of these most memorable of all days were crowned.

Crucifixion was a punishment appropriated to slaves guilty of some atrocious crime. It was a death of torture as well as of infamy, and in extorting from his cowardly and worthless judge his condemnation to this punishment, the intention of his enemies, doubtless, was not merely to gratify their malice, —though there is nothing more inveterate than the fierceness of religious bigotry,—but to stamp disgrace upon his pretensions, by causing his end to contrast so fearfully with the high character he assumed. But they were thus, unknown to themselves, fulfilling the gracious designs of the Eternal. Their worldly hearts refused to believe the prophecies which predicted a suffering Saviour. They were, therefore, wilfully ignorant that Messiah was to be 'cut off, but not for himself;'* that he was to be 'led as a lamb to the slaughter,' and wounded for transgressions not his own, 'the Lord laying on him the iniquities of us all.'† It is thus that God turns the wisdom of the wise to folly, and entraps the wicked in their own net.

The last hours of our Lord's life were but a more vivid

* Dan. ix. 26. † Isaiah liii.

and concentrated exemplification of that Divine dignity, mingled with human lowliness, which characterized the whole life of Jesus, and marked him as at once the Son of God and the Son of man. From his birth to his death, we see the Godhead constantly breaking forth through the veil of humanity, and shining more glorious in the midst of moral darkness, like the sun when he bursts in a day of storm through troubled clouds.

Let us look at the scene before us—Jesus is nailed to the cross. To all human appearance he is a helpless mortal, coerced by superior power, and however meekly he yields, yet forced to yield to the cruel sentence of the law. He shows no reluctance. He utters no complaint. He has borne every indignity without even a look of resentment,—and now he submissively bends his body to his persecutors as they proceed with their wretched task. All this, however, might be construed by his enemies into the obduracy of despair. But is there nothing more?—See! He raises his eyes to heaven. It is in prayer. He speaks.—'Father forgive them, for they know not what they do!' These simple, but most memorable words, reveal at once the inward current of his thoughts, and breathe forth, in that hour of bodily anguish, the very spirit of peace and love with which his religion is fraught.

Another instance of the same generous disregard of self, and tender attention to the welfare of others, which so strikingly marked the character of Jesus, was displayed in an incident noticed by the apostle, whom it more immediately affected; and I state it, without further comment, in the simple words in which it is recorded. 'Now, there stood by the cross of Jesus his mother, and his mother's sister, Mary, the wife of Cleophas, and Mary Magdalene. When Jesus therefore saw his mother, and the disciple, standing by whom he loved, he said unto his mother, "Woman, behold, thy son." Then said he to the disciple, "Behold thy mother." And from that hour that disciple took her to his own home.'* I do not know that any words could convey a more impressive

* John xix. 25–27.

view of deep and tender affection triumphing over the pangs of torture, or could present, in a more endearing light, that character, the most remarkable feature of which was *love*.

There is yet another incident recorded to have occurred while Jesus was hanging on the cross, and undergoing a lingering death by torture, which is strongly characteristic, and is full of hope to the penitent. He had been crucified between two thieves. One of these, true to the hardening nature of his desperate profession, joined with the infuriated mob in reviling him; but the other, in that latest hour of his life, having had his darkened heart enlightened by a ray from heaven, saw the glory, unseen to the eye of sense, which surrounded the person of his fellow-sufferer, and, with surpassing faith, exclaimed, 'Lord, remember me when thou comest into thy kingdom!' Instantly the prayer received a gracious answer. 'Verily, I say unto thee, to-day shalt thou be with me in paradise.'

Of the occurrences which took place during the period of the Crucifixion, there was one of a miraculous nature, which could not fail to affect the beholders with awe, striking terror into the hearts of Christ's enemies, and filling his friends with a trembling and short-lived hope. It is mentioned by three of the evangelists, with that beautiful simplicity which is so characteristic of their writings. 'Now, from the sixth hour there was darkness over all the land until the ninth hour.' It was during this mysterious darkness that Jesus, oppressed with a sense of desertion, which formed the climax of his sufferings, exclaimed, in the prophetic words of the 22d Psalm, 'My God, my God, why (or rather how far) hast thou forsaken me!' and then, after an interval, during which his vicarious sufferings were completed, and a guilty world was saved, he again raised his voice, exclaiming, 'It is finished;' and last of all, bowing his head, and saying, 'Father, into thy hands I commit my spirit,' he yielded up the ghost. 'And behold the vail of the temple was rent in twain from the top to the bottom, and the earth did quake, and the rocks rent; and the graves were opened; and many bodies of the

saints that slept arose, and came out of the graves after his resurrection, and went into the Holy City, and appeared unto many.'*

It is added, that even the Roman centurion, who guarded the Crucifixion, was so struck with the supernatural scene, and with all that he had witnessed, that he called out in sudden conviction, 'Truly, this was the Son of God!' In this sentiment his soldiers are recorded to have sympathized; and, when we reflect, we shall not be surprised that, heathens though they were, this effect was produced on their minds. They had been officially appointed to preserve order during the execution of three individuals condemned to the ignominious death of the cross, of whom, one, as they had probably heard, was held by some to be the Son of God, while, by the Jewish rulers, he had been accused of blasphemy for assuming this title, and had, in consequence, been condemned by the Roman Governor. Their curiosity might probably be excited by such an account, vague as it was; and it was natural for them to watch with some interest, during the trying scene, the conduct of one whose pretensions were so high. From the scoffs and insults of the infuriated rabble, their attention would therefore be turned on the meek and patient sufferer. How unspeakably must they have been struck with his whole deportment, so totally unlike that of a hypocrite or blasphemer. His look of earnest entreaty, when he raised his compassionate eyes to heaven, and prayed for his murderers; of tender affection, when he turned them on his mother and his friend, and directed their love for him into sympathy towards each other; of Godlike dignity, when he accepted the petition of the penitent thief, and pronounced his salvation; of soul-withering anguish, when he writhed under the consciousness of abandonment by his God; of triumphant joy, when to him the returning smile of his Father announced that the victory was gained, and the sacrifice for sin was complete; of confidence in a Father's love when he bowed his head and died—all these varied actions and emotions—so ad-

* Matthew xxvii. 51–53.

mirable—so divine—so astonishingly contrasting with his outward circumstances—must have affected the mind of a disinterested spectator, even more powerfully than the miraculous darkness, the earthquake, and the rending rocks; and they render the exclamation of the centurion no other than the voice of Nature itself.

Truly, this is the Son of God!—Yet he was not so esteemed by the Jews. And how many of the children of men—of that guilty race, for whose salvation he thus generously suffered—have, from that day to the present, proudly scorned and rejected him! It would seem as if they were more insensible than inanimate nature, which sympathized in his agony. This solemn sentiment is feelingly and indignantly expressed by an Italian poet;* and I close the present paper by quoting it from the fine translation of Montgomery, a kindred spirit.

'I asked the Heavens—"What foe to God hath done
This unexampled deed?" The Heavens exclaim—
"'Twas man—and we in horror snatched the sun
From such a spectacle of guilt and shame."

* * * * * *

'I ask'd the earth—the earth replied aghast,
"'Twas man—and such strange pangs my bosom rent,
That still I groan and shudder at the past."—
To man—gay, smiling, thoughtless man, I went,
And asked him next.—*He* turn'd a scornful eye,
Shook his proud head—and deign'd me no reply.'

TWELFTH WEEK—SATURDAY.

THE GRAVE.

If we could transport ourselves in imagination to the morning of the day which succeeded the Crucifixion, we should be able to form a better estimate of the feelings which perplexed and agitated the minds of the disciples. The Shep-

* Cresembini.

herd was smitten, and the flock was scattered. They had trusted that this was he who should redeem Israel;—but what could they now think? They probably did not give up all hope even when they saw him extended on the cross. Perhaps they remembered his words, which appeared to them so mysterious when they were uttered, 'I, if I be lifted up from the earth, will draw all men unto me.' This, and various expressions of a similar import, are not unlikely to have kept their faith in exercise during the awful scene; and, having banished from their unwilling minds all that he had predicted concerning his death, they may have anxiously expected, even at this eventful hour, some miraculous interference to confirm all their fond anticipations. His triumphant enemies were heard to exclaim in derision, 'Let him now come down from the cross, and we will believe him;' and it may have seemed to their half informed minds a fitting opportunity for the Eternal to interpose and vindicate the insulted majesty of his own Son. The miraculous darkness which succeeded, the earthquake, and the rending of the rocks, would all seem to them to confess a present God, and they doubtless flattered themselves that their hopes were at last about to be realized.

But when their Master gave up the ghost, and all these indications of Divine wrath passed away, their depression would naturally become as deep as their previous hopes were high. They saw him dead and buried, and they felt as if all their hopes were buried with him. There he lay in the silent tomb, while Nature resumed its wonted course. The evening sun had set as glorious, and risen as serenely to bless the smiling earth, as if he had not withdrawn his beams, and refused to look on, while the deed of horror was doing. It was thus that the Jewish Sabbath began, and thus it ended. Never, assuredly, was God's hallowed day spent by holy men in such despair.

It was ignorance, however, of an essential doctrine of our most holy faith—for even the apostles had still much to learn—which gave rise to this despair. They had yet to be taught

the fundamental truth, that Christ had died a sacrifice to satisfy divine justice, himself at once the Priest and the Victim. Had they but got a view of this invaluable doctrine, their perplexity would have been changed into admiration, and their despair into hope and joy. They would then have perceived with devout adoration, that if God's ways are not as our ways, it is because as heaven is higher than the earth, so are his thoughts higher than our thoughts.

The doctrine of substitution had long been familiar to the Jews, and was indeed intimately connected with various parts of their peculiar polity. Vicarious punishment, in particular, was recognized in their sacrifices, the animal slain at the altar being understood to bear the punishment due to the sins of him who offered the expiatory sacrifice. Perhaps by those only whose minds were divinely enlightened, were these offerings known to have a deeper meaning, and to derive all their efficacy from that one great sacrifice, which was to be offered up once for all for the remission of sins. But, howsoever this may be, it is at least certain, that these acknowledged substitutions prepared the way for the more ready reception of that great doctrine, which lies at the foundation of all our hopes. And, what is not a little remarkable, the very same doctrine was extensively diffused over the heathen world—the sacrifices which they offered up to their false deities, depending on precisely the same principle of vicarious punishment.

It is this essential and mysterious doctrine, which shows the necessity of another doctrine, equally essential and equally mysterious—that of the incarnation of the Second Person of the Godhead. The argument may, in few words, be stated thus:—Man is a sinner; but the holiness of God, who is of purer eyes than to behold iniquity—and the justice of God, which is infinite, and therefore inexorable, required the punishment of sin. Hence sin could not be forgiven;—but it might be atoned for—that is to say, it might be punished in the person of a substitute. In such a substitute, however, some very peculiar qualities were necessary. These may be

understood by comparing sin to a debt, and the substitute to a surety. The surety is one who is not naturally bound to pay, but who voluntarily substitutes himself in place of the debtor; and, before he can be accepted, it must be shown that he has the means of discharging the debt. Apply these principles to Christ. He voluntarily offers himself as our surety; and, seeing our desperate circumstances, the love which induced him to do so, could be nothing short of infinite. But is he able to discharge the debt? Assuredly not, if he be a mere man,—even although he be a sinless man; for, in such a case, he is a *creature;* and creatures have nothing to give to the Creator. Every thought, and word, and action of their lives, the whole powers and faculties of their bodies and their souls, are already due to Him from whom they derive their being. They are already indebted, to speak in the language of the metaphor we have employed, up to the utmost extent of their means on their own account; they cannot, therefore, pay what is due by others. This view includes the highest, as well as the lowest orders of created intelligences; and angels and archangels are not less impotent for such an object than man.

This shuts us up to the belief, that no one inferior to God himself,—the uncreated, independent God, could make the necessary atonement. How then?—Can God suffer? Can God die?—Impossible! It was necessary that the atonement should be made in the created and mortal nature which had offended. And here we see a solution of the most amazing and mysterious of all enigmas,—'God manifest in the flesh.' It behoved the Redeemer to be man, that he might suffer; it behoved him to be God, that the atonement might be independent, efficacious, and complete.

How amazing is all this! How infinitely beyond the powers of the human mind to comprehend! Paul, in adverting to the subject, in his epistle to the Ephesians, seems deeply impressed with the inadequacy of language to give utterance to the feelings which it is calculated to inspire; and prays that God would grant them to be 'strengthened with all

might by his Spirit in the inner man, that they might be able to comprehend what is the breadth, and length, and depth, and height,—and to know the love of Christ, which passeth knowledge.' In the whole of that remarkable passage, and in similar passages of this apostle's writings, there is a labouring for words which is exceedingly striking; and this corresponds with the experience, and calls forth the sympathies, of all who have attempted to form some distinct conception of the subject, the vastness of which no created intelligence can adequately grasp. 'These things the angels desire to look into.'

THIRTEENTH WEEK—SUNDAY.

THE RESURRECTION.

Once more we have been permitted to see the light of a returning Sabbath,—another day of the Son of Man. Again are we called upon to pause amid our worldly occupations, and, looking around us, to 'praise the Lord for his goodness, and for his wonderful works to the children of men.' When we look abroad upon the wakening earth, the green resurrection which everywhere refreshes the eye, peculiarly harmonizes with the contemplations which arise in the mind on such a Sabbath as this. But what is the winter of the natural year, compared to the desolate feelings of the disciples at the hour when they saw the remains of their Lord laid in the sepulchre. Their love, their hope, their mysterious and undefined faith, were all entombed there, and they knew not where to turn for consolation. Those of them who, restless and agitated, arose before day, desiring in some degree to alleviate their woe, by paying a small tribute of respect to the remains of their Master, were even in this to be disappointed. What must have been the shock to their feelings, when the idea forced itself on their minds, that perhaps even fresh indigni-

ties were to be exercised on the lifeless frame of him whom their souls loved. It was winter in the soul of Mary when she replied to the—'Woman, why weepest thou?' of the angel, 'Because they have taken away my Lord, and I know not where they have laid him.' We cannot fathom her suppressed anguish, when she petitioned the supposed gardener, 'Sir, if thou have borne him hence, tell me where thou hast laid him, and I will take him away.' If such was her agony, what then must have been her joy, when she found her living and risen Lord so near, and uttered the word—'Rabboni.' The simplicity of the Gospel narrative warns me to beware of attempting to describe or amplify such emotions. That they were sustained, and that the revulsion of her feelings did not overwhelm her mind, or drive it to take refuge in insensibility, was, because He who knoweth our frame and remembereth we are dust, regarded the low estate of his handmaiden, and caused her spirit to be strong and to rejoice in God her Saviour. 'Blessed is she that believeth.' Here was a revolution, of which the change from winter to spring forms but a feeble exemplification! What is the enjoyment of all that can regale the bodily senses,—what is the promise of abounding corn and wine, compared to this! Each returning Sabbath, is designed to commemorate the resurrection of the Anointed One from the grave. But more than each returning Sabbath does the anniversary of the real day, lead us to sympathize with these mourning and rejoicing disciples, the depth and variety of whose emotions, we cannot, with the utmost stretch of our imagination, hope to realize.

It was on this day, that, 'having finished his work, having suffered the penalty due to guilty man, the Redeemer burst asunder the bands of death, and, issuing from the portals of the tomb, afforded, not to the disciples alone, but to believers in every age, the pledge that his expiation had been accepted, that his victory was complete, and that, 'like as he was raised from the dead by the glory of the Father, even so they also should walk in newness of life.'

By his resurrection, Jesus sealed the truth of all which he

had taught on earth, and proved that he who, as God, 'had power to lay down his life, and had power to take it again,' had power also to confer upon his servants those rich rewards, which he promised, which he purchased, and which he has ascended to his Father's right hand to bestow.

When the deriding multitude cried out, 'He saved others, himself he cannot save,' how little could they comprehend the reason why he could not save himself. Could not He have 'come down from the cross,' who could not be holden even by the grave? How easily could the legions of angels, who hovered spectators of the solemn scene, had they been commanded, have manifested themselves to the sight of these scoffers? All their powers of just indignation, of holy reverence, of astonished and offended veneration, were ready to spring forth, for the destruction of the impious throng, who were parties to the dismal transaction. But one power, stronger than all these, withheld them. On account of that one power 'himself he could not save.' And what was that power? Love,—love that submitted to ignominy,—that contemned anguish,—that endured wrath,—that was stronger than death,—that was more powerful than the grave,—love that suffered no shadow of change, till the Saviour could exclaim, 'It is finished;' till he could send to his brethren, and say, 'I ascend to my Father, and your Father, to my God, and your God.'

'Himself he cannot save!'
This is his highest praise:
Himself for others' sake he gave,
And suffered in their place.

'It were an easy part
For him the cross to fly;
But love to sinners fill'd his heart,
And made him choose to die.'

Had not the Saviour risen from the dead, our faith must have been vain;* as Christians, of all men, we must have been the most miserable, and our last moments must have

* See 1 Corinthians, chap. xv.

been darkened by the horrors of unmitigated despair. But (blessed be God!) we are not left in doubt. 'Christ has conquered death, and him that hath the power of death, even the devil.' He has risen, and has 'become the first fruits of them that sleep.' To this we look, as the ground of that 'hope, which is full of immortality.' Difficulties we may have to contend with; tribulation we may have to endure; and in death we *must* lie down. But if we are in Christ, we shall be enabled to bear up amidst all that is calculated to agitate and alarm us, and to look beyond death and the grave, to that bright and unfading inheritance, where Christ sitteth at the right hand of God, as our Mediator and Advocate, and from whence he shall come and 'receive us unto himself, that where he is, there we may be also.' Are we destined to endure persecution for righteousness' sake? Is the ridicule, the contempt, and the hatred of thoughtless worldlings to be our portion? Let our souls be animated, and our spirits cheered, by the reflection, that, in all our sorrows, we are sympathized with by our risen Saviour, who 'endured the contradiction of sinners against himself,' and 'by whose stripes we are healed,' who will strengthen us for the faithful discharge of duty, and who at length will bestow upon us that 'crown of life,' which will far more than compensate us for the toils and dangers of our conflict here.

Are we oppressed with the complicated sorrows of life? Still we are forbidden to despond. The Son of Man 'had not where to lay his head;' he was a wanderer and an outcast; he wept, he groaned, he suffered,—and now he reigns in glory. He was like us once, but he has *risen;* and, 'when he shall appear, we shall be *like him*, for we shall see him as he is.' Have those who are dearest to out heart, and loveliest in our eyes, been snatched away from us by death, and must we too encounter the shock of dissolution? Still let us look to Him 'who died for our offences, and rose again for our justification,' and who has said, 'Because I live, ye shall live also.' And let our faith in him, as 'the Resurrection and the life,' be strengthened, when we remember, that the body in which our Lord

appeared on earth, in which he suffered and died, and in which he rose again, was in every respect similar to our own. That same body, which was subject to pain and ignominy, and which was laid in the grave, he has carried with him—now a glorified body—into heaven, and will retain for ever upon his eternal throne. And shall not this body which I inhabit be also raised again from the tomb, and, having all its vileness purged away, 'be fashioned like unto his glorious body,' and be for ever in his presence, and in the enjoyment of 'his favour, which is life?'

Trusting to those laws of Nature which the Almighty has established, the husbandman does not fear to commit the precious seed to the bosom of the earth, well knowing that there it shall lie safe and unharmed by the desolating tempests that sweep above it, till the voice of Spring shall bid it awake, and put forth its dormant energies. And with yet greater, with perfect confidence, may the Christian resign this frail and perishing body to the darkness and corruption of the tomb, assured that there it shall securely rest from all the strife and turmoil of this evil world, till that morning shall dawn, when the quickening voice of the archangel, and the blast of the trump of God, shall call it forth, renewed and purified from all imperfection, to meet with a risen and reigning Saviour, and with those departed ones who have 'fallen asleep in Jesus,' and whom 'God will then bring with him.' J. R. D.

THIRTEENTH WEEK—MONDAY.

ENJOYMENT EQUALLY DISTRIBUTED.

Man is an animal of all climates; and in them all, though differing in complexion and in some minute particulars of form, he is essentially the same. His various tribes gradually shade off, as it were, one into another, along with the climate and productions which surround him; but when we compare the extremes of his condition, the contrast is very striking;

and it is no mean proof of benevolent arrangement, that the same physical and mental powers should be capable of being accommodated to such opposite circumstances.

Let us figure to ourselves an inhabitant of some peculiarly favoured spot, with all the powers of nature contributing to his gratification,—the clear blue sky above his head, shaded occasionally by clouds which drop down fatness in fertilizing showers;—the green earth beneath his feet, throwing from her bountiful lap a profusion of flowers in every form of loveliness;—around him venerable trees, full of leafy honours, stretching wide their branches, to afford him a grateful shelter from the meridian heat, or teeming with fruit to gratify his taste;—hard by, the sparkling of a cool transparent stream, as it hastens to join the broad river, flowing majestically through meadows of emerald, to lose itself in the distant ocean;—in his groves, birds of varied notes cheering him with their sweet music;—on his lawns the lowing of cattle, on his hills the bleating of sheep;—in his stables, beasts of draught to cultivate his fields, and of burden to convey him swiftly and at his ease on distant journeys;—in his house, all the comforts, conveniences, and luxuries which commerce has collected from distant climes, and ingenuity has prepared for his use;—in his family, servants obedient to his nod,—a beloved partner of his bosom, and dutiful children, who kindle while they reflect the glance of a parent's eye.—Such is civilized man, favoured by Heaven in a land overflowing with the gifts of nature.

Look now at the opposite picture presented by the inhabitant of the frozen north. For him no tree waves, no verdure smiles, no flowers display their beauties or diffuse their sweets; the rigid earth rings beneath his feet, or is hid from his view in its cold and cheerless mantle of snow; no fruits drop to please his palate; scarce a vegetable springs from the barren earth to contribute to his subsistence; he hears no music of birds, no lowing of cattle, no bleating of sheep; all around, not a whisper is breathed, unless when the solemn and profound silence is interrupted by the occasional sound of the hu-

man voice, or the raging of the tempest, or, perchance, the growl of the polar bear, or the wolf's long howl, or the barking of the domestic dog, the devoted companion of man in every region of the earth. His house is a temporary structure of snow, to be dissolved when the sun, absent for many a dreary month, again raises himself in the heavens, and cheers the scene with his languid smile, or a rude hut of earth and stones, to be abandoned when hasty winter again comes to extend his rigid sway over that region of gloom. In such a land of sterility it would be impossible for human beings to exist, were it not that what the niggardly soil denies, is supplied by the prolific ocean; and the native, rendered inventive by necessity and adventurous by habit, has discovered the means of drawing his subsistence from the bosom of the deep, by boring the solid ice, or launching his slender skiff on the stormy waves.

To the man who has been accustomed to the comforts and conveniences of a genial clime, nothing can be more repulsive, or more full of horror, than such a condition as this. To him it seems passing strange that a fellow-creature should possess sufficient energy of mind to survive such a complication of evils. Yet he not only survives, but enjoys life. So true is this, that if we regard mere animal gratifications, it may justly be questioned if the inhabitant of the most favoured climate, amidst all his abundance, has in reality a greater share of pleasure than the inhabitant of the polar regions in his wastes of snow; and if we regard mental enjoyments, these depend so much on circumstances unconnected with external comforts and possessions, that still their superiority may be doubtful. There is nothing to create a smile in the question, whether the patient, humble, pious Greenlander, scantily supplied though he be with natural light and warmth, but illuminated by the Son of Righteousness, is not as happy in his inmost soul as his brother of earth, the servant of the same Master, and the cherisher of the same immortal hopes, when surrounded with all the luxuries of the East.

There appears at first sight to be something paradoxical in

this statement; it is, nevertheless, capable of being supported on satisfactory grounds. When we come to analyze and practically to examine the enjoyments arising from the mere gratification of the senses, we find them subject to many abatements. Long possession satiates—constant indulgence cloys—the pampered appetite becomes dainty and craving. There is a point beyond which delight changes its very nature, and is converted into pain;—

> 'Tis pleasure to a certain bound,
> Beyond 'tis agony.

When we deduct all these circumstances from the sum of enjoyment; and when we farther remember that over-indulgence in any of the grosser gratifications of the senses, induces disease, premature old age, and death, we will be forced to detract materially from the amount of enjoyment received from this source, even where the means of indulgence is unlimited. The truth is, that we are not formed for the intense and constant gratification of our appetites and passions; and he who violates the moderation of nature in this respect, may lay his account with suffering the punishment due to his selfishness. This result is altogether independent of remorse of conscience, which is another element that occurs to limit most materially the bounds of corporeal enjoyment.

If we now turn again to the simple inhabitant of the northern regions, we shall find, that as his fellow of the south has his means of physical gratification limited and fettered, so to him the susceptibility of physical discomfort is abated with an indulgent hand. His body is rendered, in a great measure, callous to the sensations of cold, and, wrapped in his skins, he can sleep as sweetly on a bed of snow, in a dwelling of snow, as the most luxurious of the children of more genial climes can rest on a couch of down, in an apartment where art has lavished all her refinements. If his appetite has been less delicately pampered, it is at least accommodated to the fare provided for it; and those who have witnessed the inhabitants of Labrador, indulging in a plentiful meal after a period of

necessary abstinence, will not hesitate to place the pleasures of the feast at least on an equal footing with those enjoyed by the most refined epicure, when gloating over some favourite repast.

Thus equally are the pleasures derived from our physical constitution, divided among the human family. With regard to intellectual enjoyment, its distribution is every where partial, depending, as it does, in every climate, upon mental improvement; and it is only enjoyed more abundantly in less sterile regions, because opportunities of improvement are more abundant. The time was, however, when even remote and dreary Iceland was enlightened, by the beams of science, and, till this day, her natives alleviate the tedium of their gloomy winter by the enjoyment of their intellectual feasts. But where this source of pleasure is wanting, there is at the same time wanting all knowledge of the privation. The desires and the hopes of the untutored natives are limited to their means; and this adaptation is another proof of the beneficent administration of a Father-God.

Such considerations lead us to the conclusion, that, under all circumstances of climate and produce, enjoyment, so far as it depends on physical condition, is far less unequal than might at first sight be supposed; and we are, at the same time, reminded that it is vain for us to expect very intense satisfaction from the mere indulgence of the senses, destined, as we are, to aspire far higher, and to drink of happiness far deeper; and as to this purer and nobler happiness,

'Tis nowhere to be found, or everywhere.

THIRTEENTH WEEK—TUESDAY.

THE ENJOYMENTS OF THE POOR IN SPRING.

This is truly the glad season of the year. Wherever we turn our eyes, Nature wears a smile of joy, as if, freed from the storms and cold of winter, she consciously revelled in all

the luxury of Spring. The lengthening day, the increasing warmth of the air, and the gradually deepening green of the awakened earth, excite in every breast a lively sense of gratitude, and pleasingly affect the imagination. A walk among the woods or fields, in a calm spring day, when the trees are bursting forth into beauty, and all the land is echoing with song, may well soothe the stormiest passions, and inspire that 'vernal delight,' which is able 'to drive away all sadness but despair.' The mind sympathizes with the joy of inanimate nature, and rejoices to behold the reviving beauty of the earth, as if itself had escaped from a period of gloom, to bask in the sunshine of hope and enjoyment.

We are familiar with the joys of Spring, as felt or described by poets and other ardent lovers of Nature. They form the burden of many a poetic strain, and excite to many a meditative reverie. They have inspired enthusiasm and deep delight, ever since there was an eye to witness, or a mind to feel, the harmony and loveliness of this gorgeously-arrayed and breathing world. They are the source of exquisite emotion to every mind, in which dwells a sense of beauty and creative design. They also light the brow of care, and bring back the flush of health and hope to the pale and wasted cheek. And not only by the rich and the unenlightened,—by the children of luxury and mental refinement—are the fine and indescribable delights of this season deeply felt and valued;—spring is also a time of increased enjoyment to the poor. It fills the inmates of many an humble dwelling with gladness, and makes even desponding poverty smile and hope for better days.

There is something in the flowery sweetness and genial warmth of spring that kindles in the rudest bosom feelings of gratitude and pleasure. The contrast to the cold and desolation of winter is so striking and agreeable, that every heart, unless it be hardened by the direst ignorance and crime, is melted to love and pious emotion; and breathings of deep-felt adoration escape from the most untutored lips. The carols of the ploughman, as he traverses the field the live-long day,

and turns up the fresh soil, seem to bespeak a lightsome heart, and evince the utmost joyousness of labour. The shepherd, as he sits upon the hill-side, and surveys his quiet flock, with its sportive companies of lambs, those sweetest emblems of innocent mirth,—feels a joy and a calm satisfaction, that is heightened by the recollection of the vanished snow-storms of recent winter, and of all the anxieties and toils attending his peculiar charge. Even the hard-working mechanic of the village or town shares the general gladness of the season. As he strolls in sweet relaxation into the glittering fields, or along the blossoming hedgerows and lanes, haply supporting with his hand the tottering footsteps of his child, or carrying the tender infant in his arms, he breathes the freshening air, treads the reviving turf beneath his feet, and inhales the first faint perfumes, and listens to the first melodies of the year, with an enjoyment that his untaught powers of expression cannot describe. The children of our cottages also,—whose lot is often poverty approaching to want, and whose joys are always but limited, and of the humblest kind,—appear in their own manner, to enjoy the fine days. How many happy hours they now spend basking and sporting upon the sunny hill, or gathering wild flowers by the brook, building the frail house of turf and green boughs, or plaiting the little rushes into every fantastic shape! And with what delight do they search for, and find the bird-nest at the hedge-root, or among the blossoming furze! Would that their own sympathies taught them to spare the tender brood, and the feelings of the fond mother, while they revel in those rural and healthy sports, by which a kind Providence has counterbalanced their numerous privations!

In the country, there is usually least demand for labour in winter, when agricultural operations are either necessarily limited, or are retarded by the severity and changeableness of the weather. The poor labourer, whose family depends, from day to day, upon the proceeds of his toil, is thus frequently thrown out of employment, when the rigours of the season render it most necessary. In the long winter months,

his supply of food is often scanty, and fuel is, perhaps, also wanting, to make his hearth cheerful, and keep out the piercing cold. But with spring come more certain and pleasant labours, longer and more genial days, soft winds, and warming sunshine; and then his wife and family, the dear partners of his privations, share with him a more liberal supply of the necessaries of life, and, stirred by the sweet influences of the season, bless with him the bountiful Author of Nature, who forgets not, but kindly regards, the humblest of his children. In the calm spring evenings, what delightful hours the cottager spends in his little garden! With a heart buoyant with enjoyment, he delves the useful plot of ground, and, in joyful hope, commits to the earth his few simple plants and seeds. He is surrounded with officious little labourers, who strive to assist him, but haply only mar his work, and whose attention is divided between the business of the evening, and the violets and daisies that spring up in the turf-walk beneath their feet. He is not without a feeling,—unuttered though it be,—of the sweetness of spring, and the delights of the passing hour; for, as the shades of night fall darkly on the scene, he leans upon his spade, and lingers to breathe the odorous air, to hear the faint murmur of his wearied bees, now settling peaceably in their hive for the night, and the glad notes of birds dying melodiously away in the inner woods.

Cowper, that most delightful of poets, has, with exquisite feeling and beauty of expression, thus alluded to the enjoyments of the poor at this season:—

> 'Even in the spring and play-time of the year,
> That calls the unwonted villager abroad,
> With all her little ones, a sportive train,
> To gather king-cups in the yellow mead,
> And prick their hair with daisies, or to pick
> A cheap but wholesome salad from the brook.'

Here we have a picture, which we hope is not merely ideal. It must surely be a pleasure to all, to consider it as copied from Nature. It is customary, we know, to estimate at a small amount the sensibilities of the poor, and to paint

poverty as a state of life unblest by any of the finer emotions. But, though it must be admitted that extreme poverty too frequently demoralizes and hardens the character, by fostering a sullen discontent, and giving rise to a spirit of gloomy desperation, how often do we find, even among the poorest classes, a strong though uncultivated sentiment of natural beauty, a keen sense of rural enjoyment, along with all the unsophisticated feelings of our nature? God hath not so partially distributed happiness, as to exclude the meanest of his children from the joys peculiar to this animating season. He has planted in the bosoms of them all the germ of that love of Nature, which, in all countries and climes, has been so productive of enjoyment, and which lies at the foundation of all the Imaginative Arts. There is often as much true vernal joy felt in the village mead, as in the luxuriant lawns of the opulent.

O let us bless the great Creator, who has scattered so much beauty and delightful variety over his works, and has given to all the power of enjoying them; who has put so much happiness within the reach of poverty itself; and has decked forth a world, that even sin is not allowed wholly to mar or destroy! J. D.

THIRTEENTH WEEK—WEDNESDAY.

THE WOODS.

WINTER has now finally retreated northwards, and left the reviving land to the mild influences of spring. The last spots of snow, the skirts of his cold robe, are dissolving upon the mountain's breast; the air is daily becoming warmer, the sky more serene; and soon will field, forest, and garden be arrayed in their ample summer garments. The sun now, in the course of his daily journey, often shines with full splendour upon the joyful scenery of earth and ocean, and is often veiled by the passing cloud, that casts its silvery rain upon the

fields. Mountain and plain are chequered with flying shade and sunshine, and beautified with golden gleams and fragments of broken rainbows. The young blades, leaves, and flowers, are no sooner thickly strewn with glittering drops of rain, than they are dried by the sunny breeze, and yield to it their sweetest odours. Then every plant is in motion, gracefully waving its shoots or boughs, as if in token of gladness at the vital impulses of the season.

How pleasant, at this time, a rambling walk in the woods! not along the beaten gravel-path, formed by the art of man, but among the wild untrodden copses, the inner forest shrines, where the spontaneous vegetation of nature is least interfered with, where the sweetest birds sing, and the wildest flowerets blow, undisturbed and unseen, in the solitude of the sequestered sylvan shades. There, on every side, unobserved by the common eye, works a life-giving energy, that now clothes the stately tree, the stunted underwood, and the grass and flowers beneath, with the freshest beauty and bloom. There, all the trees are bursting into luxuriant foliage; and the leafy skreen, spread around and overhead, is daily becoming darker and more impervious. The oak is already clothed in a tender and yellowish-green, and is gradually assuming a darker verdure; the beech throws on high its bright green rustling canopy; near it the fragrant birch hangs its pensile branches, reclothed by the breath of spring; and the large buds of the plane are now expanded into glossy leaves. As for the ash, it lingers behind its brethren of the forest; but the willow, the alder, the hazel, and the birch, are already clad in their vernal robes, and lead the way among the sylvan throng.

The eye is pleased with the varied beauty of the living and breathing vegetation around; every thing wears the freshness of youth—the liveliness of a new-born verdure. Even the moss upon the venerable trunk is scarcely noticed amidst the foliage of the over-arching boughs, and the vigorous encircling shoots. The sward beneath the feet, manured with the fallen leaves of a past season, is again clothed with a rank herbage, from which the moisture never exhales. Along the

steep and grassy bank, or under the dewy hazel shade, blooms in virgin beauty that lovely wilding of nature, that earliest woodland flower, the primrose. The grass is besprinkled with its yellow blossoms, which of all others chiefly recall the feelings and sports of youthful days, when, to wander through the woods, and pluck the primrose gay, formed unutterable enjoyment. The thickets of hazel and sloe-bushes, of late so naked as to expose to view the nests of a former year, which they once effectually concealed, are now darkened with buds and leaves, and are alive once more with the brisk labours of birds, and echoing with their song. If we turn to the neighbouring holly, we descry on one of its boughs the blackbird's comfortable nest, where she, with brooding instinct, already hatches her eggs; her mate meanwhile, from some adjacent bough, pouring forth, at intervals, his shrill and beautiful song. And yonder, in the young spruce-fir, whose mossy and evergreen branches afford a warm shelter, is the early nest of the thrush, firmly compacted of moss and withered straws, and plastered inside to keep out the cold night winds. The redbreast hovers about his lowly dwelling, in the decayed dike, or natural bank; and the wren, one of the tiniest, but not least skilful of architects, is seen flying with a bit of moss for the roof of her snug dwelling. And hark! the most soothing and truly sylvan of all sounds, the cooing of the wood-pigeon, issues from 'the aërial elm,' or wide-spreading beech.

'Over her own sweet voice the stock-dove broods.'

The pheasant springs up at our feet, and flies whirring away to the covert of the lonely brake, where he is seldom disturbed even by the approach of the forester. He is a bird of most splendid plume; but, all unlike his gaudy rival the peacock, he avoids the gaze of man, and frequents the unapproached recesses of the woods. Beautifully has the poet said of him,

'He, Christian-like, retreats with modest mien,
To the close copse, or far sequestered green,
And shines without desiring to be seen.'

COWPER.

The woodland brook, lately a boisterous torrent, has shrunk into its well-worn shelvy channel, and now shoots with a softened sound down the steep ravine, and, with a clearer wave and softer murmur, winds along the meadow glade, watering the twisted and exposed roots of the alders and willows on its brink, and reflecting, with every staggering glimpse of sunshine, the wild beauties of the sylvan landscape. Its winter flood-marks, consisting of boughs, leaves, and withered grass, all matted together, are still visible at some distance on each bank, and on the overhanging branches of the neighbouring shrubs and trees. Tracing upwards its wild and devious course, we come to many little rapids and cascades, and behold with admiration the miniature falls that fill the thickets with their din, and fling a gentle spray upon the water-loving shrubs that bend over them. Fancy delights to find, in the tiny and unknown stream, all the features of the mighty river. There are to be seen little shoals, and sand-banks, and shallows, deep pools and foaming cataracts —waters that at one time flow dallying along in many a winding and woody sweep, at another rush impetuously forward in a rapid and arrowy stream. Extend the course of this insignificant brook, we inwardly exclaim, and feed it as it wanders, and it will become a vast inland flood, spanned by lofty bridges, and traversed by ships from every shore ;—the Nile and the Amazon, in the first part of their course, have a channel no larger than the bed of this nameless stream.

As we approach, in our devious wandering, the interior recesses of the forest, where the path becomes rougher and wilder, the trees more lofty, and the brushwood beneath more tangled and untrimmed—where the silence is unbroken by any sound of rustic labour, or noises of flocks and herds that pasture in the open fields, and where the umbrageous vistas are darker and cooler than in the outer woodlands, a solemn reverential feeling steals upon the mind; we give way to sylvan dreams and tender reveries, gently oppressed by the very vividness of our perceptions; and we hold communion, as it were, with the stately vegetable forms around us, sym-

pathizing in their apparent joy in the process of reanimation, hearing in the murmur of the wind among their leaves an expression of delight, and breathing, in the balmy gale, the offered incense of their gratitude. We feel as if placed in a natural sanctuary, in deep seclusion from the tumult of the world. The sylvan gloom is favourable to imaginative meditation. Let us not devote it to the Pan or Sylvanus of antiquity, or to some imaginary Genius of the place, but to the great Creator of all things, whose praise ascends alike from the mountain's lofty peak, from the quiet bosom of the valley, and from the awful depths of solitary forests.

On emerging from the dark and 'leafy labyrinth,' where we have been wandering pleasingly bewildered, our ears are greeted with a multitude of cheerful rural sounds—the lowing of cattle, the bleating of sheep, the cawing of rooks hovering over their conspicuous basket dwellings in the village grove, and all the noises attendant on the field labours of the farmer; and our eyes wander with sudden delight over a wide expanse of clear and yet variegated country—green lea-fields, ploughed lands, watery meadows, banks tufted with trees and coppices, and hill-sides over-run with blossomed furze and broom. We have left a wilderness behind us, and enter upon the bright domain of cultivation, like one who, long enchanted among the dark and thorny mazes of error, is led at last to the illumined region of celestial truth. On returning homewards, let us not forget Him to whom we owe the ever-varying and ever-pleasing aspects of Nature; but consecrate to His praise the feelings and imaginings inspired by our desultory walk. Let us not have entered in vain the solemn temple of the woods. J. D.

THIRTEENTH WEEK—THURSDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—THE POWER AND INTELLIGENCE OF THE CREATOR.

In looking back on the subject which has been under our consideration, in the course of this volume, it is impossible not to be struck with the force of the cumulative argument, which a view of the reproductive operations of Spring affords, for the being and perfections of God. Every distinct instance of that contrivance, by which, amidst the universal law of decay, the species is preserved, is a separate proof of Designing Intelligence; and, when all these evidences are combined, and made to bear on each other, they form a chain of demonstration, which is not only complete and irresistible, but might even appear cumbrous by its superfluity, did we not discover, in every new example, some new grace and beauty, to interest the mind, and fill it with devout admiration.

In our temperate climate, the gradual progress of returning warmth, with its various accompaniments of increasing light, of subsiding storms, and of genial showers, is attended, as we have seen, with a corresponding development of plants, obviously suited, with studied intention, to the nature of that progress, and the respective grades of temperature in the various latitudes and local peculiarities. These plants, again, are admirably fitted to the condition of living creatures, in all their varieties, from the microscopic insect up to man. The tender stalk shoots, the green blade expands, the flower opens in its beauty, and exhales its perfume, the grain and the fruit grow and ripen, not idly to waste their vegetative powers, but to afford subsistence and enjoyment to those higher species of organized beings, with which they are associated: And, as Nature becomes more and more liberal of her vegetable stores, in the same proportion do the inhabitants of the animal world increase, to partake of the bountiful feast she spreads.

It is well worthy of remark, as an instance of those wonderful adaptations, which I have so often had occasion to notice, that the reproductive season of the vegetable creation is also that of the animal creation. When the various tribes, which have passed the winter in their embryo form, or have survived it in a state of insensibility, begin to move on the surface of the earth, they find a sweet and nutritious food newly created, as it were, for their use, varying in its kind, according to the wants of the animals destined to feed upon it. And the same thing may be said with regard to the young of those living creatures which reproduce their species at this season. The means of subsistence and of enjoyment are amply furnished both for themselves and their offspring, whether, during winter, they have been dormant in holes and caves, or have found scanty support in the half decayed herbage, or have preyed on other animals, or have plied their way from distant lands on unwearied wings.

The instincts, which so irresistibly and intelligently, and yet,—as far as regards the animal itself,—so blindly, impel almost all classes of the lower animals, at this season, to become parents, is another provision which we have noticed as a proof of beneficent design. There is no particular relating to these instincts which is not calculated to call forth the admiration and astonishment of the reflecting mind ; but, above all, the long-protracted cares and incessant toils of the feathered tribes, cannot be contemplated without a peculiar interest. That a world doomed to mortality should continue to be peopled with living beings, indicates prospective contrivance of vast magnitude and extent. The various relations and adjustments, which such a scheme implies, are such, that the bare contemplation of them overwhelms the human mind. Yet how admirably has the provision been made! With what consummate skill and forethought has every thing relating to this complicated subject been urged forward, balanced, and controlled, so that one species of the numerous tribes which teem on the earth, does not press so hard upon another, as to occasion its destruction, and yet the whole globe

is always peopled up to its resources! Into the details of the processes by which this remarkable balance has been effected and secured, I have elsewhere entered, at sufficient length, I think, to show that the more deeply the subject is considered, the more clearly the perfections of the Creator will be unfolded.

The principles on which agricultural labour depends, have also been adduced, as affording another example of beneficent contrivance, which exhibits a remarkable adjustment between the faculties of man and the powers of vegetation. That it should be reserved to man, the only rational being on the globe, by his own judicious efforts, to alter the natural balance of organized existences, so as to give scope for the more extended propagation and the increased comfort of this highest species, is itself a remarkable provision; and that these very efforts should be the means of calling forth and invigorating his faculties, both bodily and mental, and of pressing him forward in a career of improvement, of which it is impossible to foresee the termination, is a view which tends inexpressibly to elevate our conceptions of the Creator, while it causes our hearts to overflow with gratitude for the parental care which he exercises over us.

This retrospective glance over the ground we have traversed, must recall to the mind of the intelligent reader a thousand minute particulars, which, when presented to him in the course of our inquiry, struck him with irresistible force, as indications of a Divine hand. Let him now consider all these particulars, as combining to form one accumulated argument in favour of the existence and attributes of the Creator; and then let him say what he thinks of the strength of that argument. I do not ask if it be possible, by dint of a perverse ingenuity, to elude its force, or, in consequence of a depraved heart, to oppose its legitimate influence on the conduct; for I am well aware, that there is nothing too absurd for the one, or too wicked for the other;—but I ask, whether any candid mind, weighing the evidence with the calm and unbiassed feelings of a philosophical inquirer after truth, can hesitate

for a moment to admit that this evidence is complete and overflowing; and that, for a man, with these facts before him, to doubt of the being of an Almighty and Intelligent Creator, would not be a less decided mark of aberration of intellect, than to doubt of his own personal identity.

THIRTEENTH WEEK—FRIDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—THE GOODNESS OF THE CREATOR.

That God is good, is a deduction of reason from the views unfolded in the preceding papers, not less true and undeniable, than that he exists. His goodness is inferred from his having made pleasure, rather than pain, the stimulus to exertion. Dr. Paley, following Dr. Balguy, who had previously stated the argument in his 'Treatise on the Divine Benevolence,' observes, that the bestowment of certain functions and propensities, necessary to life, are not of themselves proofs of the goodness of God. They may prove the existence of a Being possessed of a high degree of power and intelligence; but then that Being may be malevolent. It may, by possibility, be supposed, that misery, and not happiness, was the object of such a Creator; and we can only with fairness infer his benevolence, when we perceive, further, that the tendency of his creation is to produce a preponderance of happiness.

Paley illustrates this view by instancing the appetite of hunger. A painful feeling of privation was necessary, as we are at present constituted, to create an effective desire for food; but it is all that was necessary, and a Creator not positively benevolent would have been contented with this stimulus. It is a proof of goodness that He has superadded some agreeable sensations to the gratification of the appetite, which were not necessary, and that He has given peculiar tastes and flavours to various kinds of food, that these sensations may be exercised.

The same reasoning applies very extensively to those propensities and instincts which are connected with reproduction. They might all have been invested with an adequate stimulus in a painful craving. It might have been merely to alleviate a constantly burning and never-satisfied appetite, that the feathered tribes, for example, were impelled to the laborious tasks of nest-building, of incubation, and of feeding and rearing their young; indifference, or even aversion, might have been made to attend the union of the parents in the prosecution of these duties; and yet, by means of new and corresponding modifications, the propagation of the species might have proceeded with the same regularity as at present. It is therefore a proof of benevolence in the Creator, that he has not only annexed pleasurable sensations to the parental duties, but has caused the enjoyment far to overbalance the pain. Evidences of the delight attending all these duties, are too obvious to require to be sought for. During the season of reproduction, every ear is saluted with the melodious voice of joy from every field, and wood, and grove. The very sky is made vocal with the enjoyments of wedded love. Look at the swallow, as it twitters from its half-built nest, to ply its laborious task, and say if there is not enjoyment there. Look at the barn-yard fowl as she patiently sits on her eggs, and continues day after day to prolong her monotonous duty, and say if even in this there is not enjoyment. Look especially at the maternal cares which attend the callow brood when hatched, and say again if there is not enjoyment. The whole important process is cheered on by conjugal and parental affection; and wherever there is gratified affection there is happiness.

But the pleasures of Spring are not confined to these exercises. The whole season is a season of enjoyment, increasing and extending towards its close. Sometimes dark clouds may lower, and storms, deforming the face of Nature, may interrupt the flow of pleasure, and even bring destruction and sorrow. But these are exceptions. The general rule is enjoyment. How sweet is the herbage for animals that graze! How tender and succulent the young leaf to the newly-

awakened insect! How soft the green carpet which the Creator has spread, at once for food and for repose to the young quadruped! How balmy the air! How genial the mitigated rays of the sun! How smiling the blue sky! How serene the fleecy clouds! How lovely the earth, with its various shades of grateful verdure, and its profusion of flowers!

To man all these things are a source of varied and never-cloying enjoyment. His Creator has endowed him with that mysterious principle of taste, which philosophers have exercised their ingenuity in defining and analyzing, and which, on whatever principles of our nature it may depend, is assuredly an important gift of a bountiful Creator, bestowed expressly for promoting human happiness. In virtue of this gift, all the productions of nature become to him objects of gratification, and all its phases sources of enjoyment. If he turn his eye to the woods, the graceful birch, the venerable oak, the beech, with its wide-spread branches, and its soft green leaves; the poplar, shooting its tall head to the sky; the humble holly, with its glossy foliage, each has its own peculiar charm, and all combined, form one harmonious and interesting whole. If he enter his garden, what a profusion of varied loveliness and sweet perfumes awaits him! Day after day, as the flowers successively expand, some new wonder of creative power and goodness attracts his eye, and gratifies his sense of smell. If he walk abroad in the fields, the rising grain and bursting hedges, in the cultivated grounds, unite with the meadows, the lawns, and the towering mountains, alike to gratify his taste, and to proclaim anew the presence of a beneficent Creator.

Even the sounds which on every side attract his ear, are full of melody. The distant echoing of the woodman's axe and the huntsman's horn, or the mellow note of the thrush, or the soft cooing of the wood-pigeon, or even the barking of a dog, or the cawing of rooks, or the crowing of the domestic cock, is each attended with an agreeable sensation;—while the nearer songs of the little birds, each on its spray, the dew-

drop trembling 'as the minstrel sweetly sings,' are a source of still softer delight; and all these sounds combined, form a chorus of melody grateful to every ear, and filling the heart of the man of refined taste with ecstacy. The sighing of the breeze, the dashing of the mountain cascade, or the gurgling of the rill, as it dances in the sunbeam, and, more perhaps than all, because attended with deeper associations, the hum of busy men, as it ascends, in the gray evening, from the neighbouring village, move the mind to gentle and pleasing musings.

The influence of external nature, in its livelier aspects, upon the feelings, is beautifully described in the 'L'Allegro' of Milton. All the pleasant sights and sounds there collected, and delicately portrayed as the elements of cheerfulness, now enliven the vernal landscape, and fill the eye and ear with 'vernal delight.' The following lively images are now felt not to be merely ideal, but derived from the living realities of Nature :—

'To hear the lark begin its flight,
And singing startle the dull night,
From his watch-tower in the skies,
Till the dappled dawn doth rise;
Then to come, in spite of sorrow,
And at my window bid good morrow,
Through the sweet-briar, or the vine,
Or the twisted eglantine;
While the cock, with lively din,
Scatters the rear of darkness thin,
And to the stack, or the barn-door,
Stoutly struts his dames before;
While the ploughman, near at hand,
Whistles o'er the furrowed land,
And the milkmaid singeth blithe,
And the mower wets his scythe,
And every shepherd tells his tale,
Under the hawthorn in the dale.'

This gladness of heart, which the season awakens, has a tendency to produce a beneficial effect on our affections, and to call them forth more tenderly towards our fellow-creatures,

—a sentiment which is thus beautifully expressed by Dr. Seed: —'We are affected with delightful sensations, when we see the inanimate part of the creation,—the meadows, flowers, and fields, in a flourishing state. There must be some rooted melancholy at the heart, when all Nature appears smiling about us, to hinder us from corresponding with the rest of the creation, and joining in the universal chorus of joy. But if meadows and trees in their cheerful verdure—if flowers in their bloom, and all the vegetable parts of the creation, in their most advantageous dress, can inspire gladness in the heart and drive away all sadness but despair, to see the rational creation happy and flourishing, ought to give us a pleasure as much superior as the latter is to the former in the scale of beings. But the pleasure is still heightened, if we ourselves have been instrumental in contributing to the happiness of our fellow-creatures,—if we have helped to raise a heart drooping beneath the weight of grief, and revived that barren and dry land, where no water is, with refreshing showers of love and kindness.'

THIRTEENTH WEEK—SATURDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—THE USE AND DEFICIENCY OF NATURAL RELIGION.

When we say that the Creator is benevolent, we only assert what Nature declares; but Nature qualifies the declaration; for the proof derived from this source is not absolute but relative. She does not display to us a world of unclouded glory and uninterrupted enjoyment, but merely a glory and enjoyment bursting from the darkness of night, triumphing over the gloom of suffering, and gilding and brightening the very clouds which envelope them. The question is, not whether the happiness of the animated world be complete, but whether it be preponderant. Evil is allowed to exist,—alas! this cannot be denied,—but then it is counterbalanced

by good,—nay, the very evil itself changes its nature in various instances, and under the beneficent operation of an overruling Providence, becomes good.

All this is demonstrable in every department of Nature, and in the course of the preceding discussions *has been* demonstrated. Yet, such a conclusion is but partially satisfactory; and, were we bound down to the deductions of Natural Religion, we should find it hard to elude the argument of those who press on us a belief in a God of only limited goodness, or limited power and intelligence. Our feelings would, indeed, revolt from a belief so wretched, and we should have good cause to suspect the soundness of reasoning which could enable the creature thus to sit in judgment on the Creator, and find him wanting. Still, I know not how the inductive reasoning of the Baconian philosophy could be applied, without landing us in this unhappy dilemma; and all that would remain for us would be to wonder at our own temerity, and tremblingly to say, 'Nay, but O man, who art thou that repliest against God?'

This, however, though it may silence, can never satisfy, the inquiring mind; and we are brought back again to a higher theology, and forced to look for the solution of our doubts where alone it is to be found,—in the revealed word of God. We have elsewhere frequently adverted to this difficulty,* and indeed are desirous that the reader should never lose sight of it. That we live in a world of alternate pleasure and pain, is what we see, and feel, and know; that this state was induced by the rebellion of man against his Creator, is what revelation alone unfolds. It is, however, the only way by which a just view of the relations and condition of the external world can be explained. If it be asked why man is but partially happy, the answer is, because he is sinful; and if it be asked again, why the lower animals are but partially happy, the answer still is, because man is sinful. God has, for the discipline of fallen man, smitten the earth with a curse.

The more we interrogate Nature, the more powerfully shall

* See the introductory chapters of the volume on 'Winter,' &c.

we be forced back on the oracles of revealed truth ; and it is on this very account that the interrogation is especially useful. We thus learn at once, the reality and extent of that curse with which she has been smitten ; and we learn also the limits of that knowledge of the Creator which she is capable of unfolding. She tells that there is a God, and affords us some insight into His natural and moral attributes. But she stops short at the very threshold of those discoveries which are most interesting to man,—I mean such as refer to the relation in which he, a sinner, stands to the holy God. There is a fine passage on this subject, in the concluding chapter of Dr. Chalmers' Bridgewater Treatise, with which I have pleasure in closing this volume, as it corresponds entirely with the views I have been inculcating, and expresses, in eloquent language, the conclusion to which I am desirous of leading the reader's mind :—

'Many there are who would gloss over the difficulties of the question, and who, in the midst of all that undoubted outrage which has been inflicted by sinful creatures on the truth, and the holiness, and the justice of God, would, by merging all the attributes of the Divinity into a placid and undistinguishing tenderness, still keep their resolute hold of heaven, as at least the splendid imagination, by which to irradiate the destinies of our species. It is thus that an airy unsupported romance has been held forth as the vehicle on which to embark all the hopes and hazards of eternity. We would not disguise the meagreness of such a system. We would not deliver the lessons of natural theology, without telling at the same time of its limits. We abjure the cruelty of that sentimentalism, which, to hush the alarms of guilty man, would rob the Deity of his perfections, and stamp a degrading mockery on his law. When expounding the arguments of natural theology, along with the doctrines which it dimly shadows forth, we must speak of the difficulties which itself suggests, but which it cannot dispose of ; we must make mention of the obscurities into which it runs, but which it is unable to dissipate,—of its unresolved doubts,—of the mysteries through

which it vainly tries to grope its uncertain way,—of its weary and fruitless efforts,—of its unutterable longings. And should, on the one hand, the speculations of human ingenuity, and, on the other, the certainties of a well-accredited Revelation, come forth to illuminate this scene of darkness, we must not so idolize the light, or the sufficiency of Nature, as to turn from the firmament's meridian blaze, that we might witness and admire the tiny lustre of the glow-worm.

'The two positions are perfectly reconcileable,—first, of the insufficiency of natural religion; and, secondly, of the great actual importance of it. It is the wise and profound saying of D'Alembert,—that "man has too little sagacity to resolve an infinity of questions, which he has yet sagacity enough to make." Now, this marks the degree in which natural theology is sagacious,—being able, from its own resources, to construct a number of cases, which, at the same time, it is not able to reduce. This must be handed up, for solution, to a higher calculus; and thus it is, that the theology of Nature and of the schools, the theology of the ethical class,—though most unsatisfactory when treated as a terminating science,—is most important, and the germ of developments, at once precious and delightful, when treated as a rudimental one. It is a science not so much of dicta as desiderata; and from the way in which these are met by the counterpart doctrines of the Gospel, the light of a powerful and most pleasing evidence is struck out by the comparison between them. It is that species of evidence which arises from the adaptation of a mould to its counterpart form; for there is precisely this sort of fitting, in the adjustment which obtains between the questions of the natural, and the responses of the supernatural, theology. For the problem which natural theology cannot resolve, the precise difficulty which it is wholly unable to meet or to overcome, is the restoration of sinners to acceptance and favour with a God of justice. All the resources and expedients of natural theology, are incompetent for this solution,—it being, in fact, the great desideratum which it cannot satisfy. Still it performs an important part, in making us sensible of

the desideratum. It makes known to us our sin, but it cannot make known to us our salvation. Let us not overlook the importance of that which it does, in its utter helplessness as to that which it does not. It puts the question, though it cannot answer the question; and no where so much as at this turning point, are both the uses and defects of natural theology so conspicuously blended.'*

* Chalmers' Bridgewater Treatise, vol. ii. pp. 286–289.

THE END.